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PILONIDAL CYST

Report of 17 Consecutive Cases Treated by Marsupialization*

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PILONIDAL cysts are the most commonly encountered lesion over the sacrococcygeal region. It is the consensus of all observers that this condition is the result of some disturbance of embryonic development. It is not the purpose of this paper to review in detail or make additions to the discussion of etiology, symptomatology, etc., but rather to present our experience with an already accepted procedure of marsupialization (exteriorization) of these cysts, with the hope that it may be useful in reducing disability time and in cutting the incidence of recurrence (now reported in the literature as between 2 and 50 per cent) down to a minimum.

The writers have used this procedure in 17 consecutive cases. One or several sinuses have been present in the region of the sacrococcygeal junction. In several there was communication with the skin by a small fistula or sinus. This series of cases varied greatly in the extent of involvement from the uninfected cyst of very small, almost insignificant proportions, to extensive previously infected cysts with ramifying deep sinuses. In some of the cysts, the inflammation was recurrent (see Scattergram Chart 1).

Fifteen of these patients were operated on in our service for the

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The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the War Department at large.

| | | | | | | | | |
|--------|-------|---------|-------|----------|-------|-------|-------|-----------------------|
| Large | | 1 | | 1 | 1 | 1 | | 1 **** 166 days |
| Medium | | ** 3 | 2 | *** 4 | 2 | | | |
| Small | * | | | | | | | |
| Days | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | |

CHART 1.

Scattergram of Total Days Hospitalized Against Size and Severity of Gross Infection of Cyst

Key: *Uninfected

**One of three not infected

***Two of four not infected

****One series failure

Note: All others possessed some degree of gross infection.

first time. The remaining 2 had had previous operations elsewhere. Of these, Case 3 had a primary closure as his first operation, with the second being an endeavor to remove the recurrent sinus tract and an attempt at primary union once again. His draining wound was carefully examined, the remaining sinus tract isolated and exteriorized. The convalescence was 58 days and uneventful. Case 11 had had an open type of first operation, with incomplete healing, with the second attempting primary closure; but this too failed completely, as part of the cyst wall had been included in the closure. His third operation consisted in opening the wound once again and exteriorizing the remaining cyst wall. Complete healing occurred in 58 days with no complications. The remainder of operated cases are listed in Table 2, with total days hospitalization. It is to be remembered that each wound was completely healed before discharge from the hospital, so that the soldier might return to full military duty. Each of the patients was ambulatory within the first 7 postoperative days, with one or two exceptions.

The one failure in this series, Case 13, is of interest. He presented himself with a huge pilonidal cyst abscess, of long standing. Incision and drainage were carried out, and after acute inflammation had subsided, he was brought to surgery for marsupialization of his cyst. Infection had destroyed a great part of the cyst wall, but that which survived was exteriorized. After many weeks of

| CASE NUMBER | AGE | TOTAL DAYS HOSPITALIZATION |
|-------------|-----|----------------------------|
| 1 | 36 | 19 |
| 2 | 26 | 25 |
| 3 | 32 | 58 * |
| 4 | 26 | 37 |
| 5 | 24 | 48 |
| 6 | 23 | 43 |
| 7 | 30 | 40 |
| 8 | 22 | 39 |
| 9 | 27 | 28 |
| 10 | 22 | 21 |
| 11 | 22 | 58 ** |
| 12 | 26 | 51 |
| 13 | 21 | 166 *** |
| 14 | 21 | 67 |
| 15 | 26 | 43 |
| 16 | 20 | 42 |
| 17 | 24 | 29 |

CHART 2.

*Two previous operations

**Two previous operations

***One series failure

Average hospitalization

of total series.....47.8 days

Average hospitalization

of 16 successful cases....40.5 days

watchful waiting, it became apparent that the modified squamous epithelial element did not cover the defect properly. A modified

Lahey-Catell operation was performed. The wound healed by primary intention, and the patient was discharged after 166 hospital days.

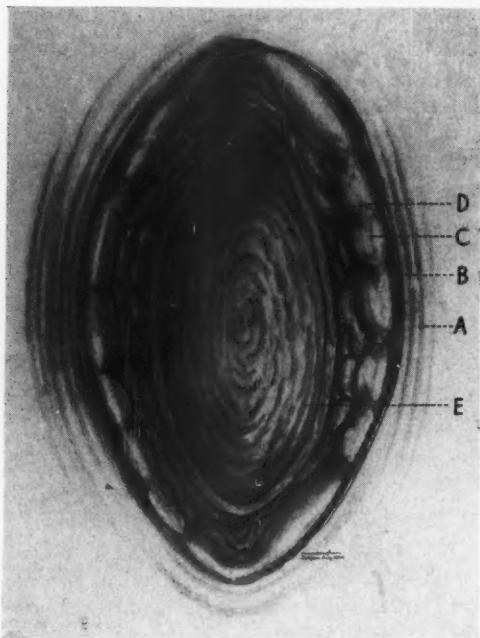


Fig. 1. A—Skin. B—Skin margin. C—Subcutaneous tissue. D—Cyst margin
E—Cyst body.

This method emphasizes that excision of the complete sac, including the epithelium-bearing tissue, is not necessary for cure of pilonidal cysts. As one editorial essayist has expressed, ". . . the primordial character of the cells potentiates at least an inherent power of growth." The surgeon has at his disposal a skin graft, more efficacious than if he had placed it there.

A low spinal anesthetic was employed in each operation. No type of dye was used to delineate the cyst with its tract ramifications. It is felt that the pictorial is confused with the smearing of the dye over the entire field, and that in some instances it is impossible for the dye to penetrate into ramifications. Because of the glistening appearance of the cyst, it is much easier, after it is cleaned, to follow its natural tissue expression. The procedure carried out is as Buie describes: "A probe is inserted into the sinus

and over it the tissues covering the cyst are split. If multiple sinuses are present, each is treated in this manner until all subsidiary tracts and the entire cavity has been opened. Then the edges of the skin,

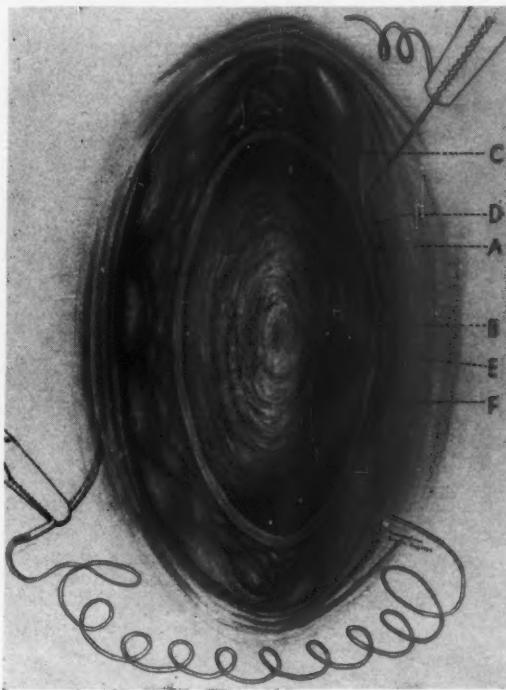


Fig. 2. A—Skin. B—Skin margin. C—Subcutaneous tissue. D—Cyst margin. E—Cyst body. F—Continuous locked stitch for approximation.

along the external and lateral walls of the cyst and sinuses are cut away leaving intact the inner walls of the cyst and its branching tracts. The edges of the skin are then sutured to the margins of the remnant of the membrane which originally enclosed the cyst and sinuses" (figs. 1, 2, 3).

No matter how careful or how skilled the surgeon, recurrences must be expected in this type of surgical series. The authors realize that, "the proof of the pudding is not the eating, but the digestion thereof." But with the use of exteriorization, if recurrence should occur, the operative treatment is simple, in that exteriorization, under local, may be carried out as in the original procedure. Another great advantage is that one has an open wound. Definitely, the lesion is an infected one, passively, if not actively, and demands

surgical principles accordingly expressed in the advantage of an open wound, which exteriorization offers. It is very difficult to prevent contamination in the sacrococcygeal region following primary closure, the reason being almost inevitable postoperative contam-

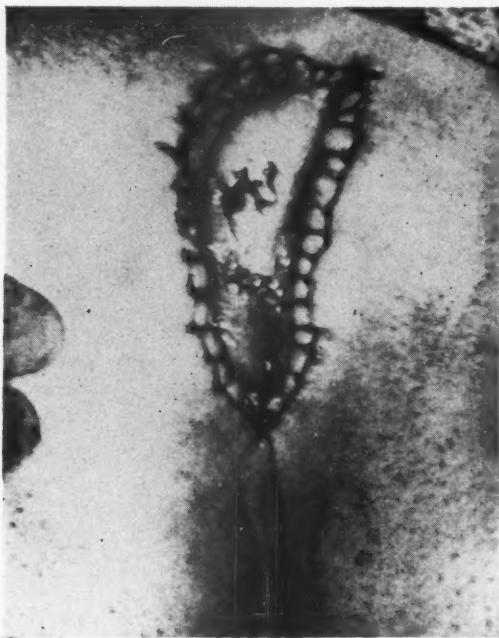


Fig. 3. Case No. 15. Exteriorization of cyst completed.

ination. This procedure also shortens the period of healing, and obviates the amount of scar tissue directly over the sacrum, which is frequently subjected to irritation and trauma. In more radical procedures, needless tissue is destroyed and the resultant defect is needlessly large.

Other procedures still have a role in the surgical treatment of pilonidal cysts. In cases in which small tracts are relatively free from infection and are confined to the midline, primary closure of the excised area may be justified. The flap operation, as originally described by Lahey Clinic, is definitely indicated in a few cases in which previous attempts to eradicate the sinus region have failed. The majority of surgeons are largely abandoning the radical excision with primary closure methods, because of the universally high incidence of recurrence. It is obvious that, without complete ex-

cision, the congenital nature of the cyst exerts itself in regeneration of a retention pocket.

CONCLUSION

The authors advocate marsupialization of pilonidal cysts, for the following reasons:

1. A less destructive procedure for repair of pilonidal cysts, utilizing the cyst wall for wound healing.
2. A greatly reduced convalescence.
3. An open wound, in an infected or potentially infected field.
4. A better resultant effect in tissue, if a recurrence must be coped with.
5. A dyeless method more efficacious in dealing with arborizations.

BEHAVIOR IN SERUM OF VARIOUS METALS USED IN BONE SURGERY

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INTRODUCTION

IN 1939 J. Albert Key, M.D., put a number of various metals to soak in Ringer's solution and observed their action over a period of years. The authors have had the opportunity to observe these metals several times and this aroused an interest as to what action human plasma or serum might have on them.

The experiment described in this paper was done on a purely empirical basis, so that the activity of the various metals used in bone surgery might be observed in human plasma. It was hoped that information of some value might be secured or that some correlation between their activity in human serum and in the body might be observed. The results of the experiment are reported in this paper purely for what they are worth and without attempting to attach undue significance to them.

THE EXPERIMENT

Several metals are used in bone and joint surgery, which include stainless steels of various types, vitallium, and tantalum. Formerly, ordinary vanadium steel was quite commonly used and it was employed in this experiment also. Vitallium and tantalum are apparently quite inert and most of the stainless steels, especially 18-8 and S.M.O., are relatively inert also. Vanadium steel, when used in bone surgery, produces a good deal of reaction and irritation in the bone, which is in sharp contrast to the other metals mentioned above. There has been, and is still going on, a controversy as to whether vitallium, and more recently tantalum, are enough more inert in bone surgery to justify their use, as contrasted with the use of stainless steel. It is a reasonably well established fact that vitallium is definitely more inert than the stainless steels and, although there has been somewhat less evidence on the subject so far, tantalum appears to be considerably more inert than the stainless steels. A great deal has been written on this subject, by Stuck, Key, and many others, and it is not within the scope of this paper to enter into this controversy, or to go into detail as to the chemistry of the various alloys. The excellent articles already written on the sub-

ject cover it quite thoroughly. In setting up the experiment, metal screws with machine type threads were used so that the threads of all the metals would be of relatively the same size. The heads and points were sawed off with a hacksaw and the pieces of screws were cut into lengths about three eighths of an inch long, each piece weighing approximately 0.5 Gm. Before putting them to soak in serum, they were very carefully cleaned with an abrasive kitchen cleanser, then with benzine, and then with ether. The pieces of metal were soaked in human serum which had been collected under sterile precautions with no preservative, antiseptic or glucose added. The serum was placed in pyrex flasks under sterile precaution. Pyrex was used because this glass has much less tendency to dissolve in serum than has ordinary glass. Every effort was made to insure asepsis, and as will be noted later only one flask became contaminated.

In this experiment it was felt desirable to place one piece of metal in one series of flasks and two pieces of the same metal in another series of flasks to try to determine how much difference in activity there would be with the increased possibility of electrolysis when two pieces of metal were placed together touching one another in the flasks. This was done and, before sterilizing the metal and placing it in the serum, the metal was very carefully weighed out to four places past the decimal point in grams.

After setting the flasks up under aseptic technic and using sterile corks, they were carefully hermetically sealed with hot paraffin. The flasks, which were of the ehrlinmeyer type, were tilted at an angle of 30 degrees and kept at room temperature. They were left for a period of exactly 2 years, and were agitated once every month by thoroughly shaking them.

When the metal was placed in the flasks, 100 c.c. of serum was used in the flasks containing two pieces of metal (approximately 1 Gm. gross weight) and 50 c.c. of serum placed in the flasks containing one piece of metal (approximately 0.5 Gm.).

RESULTS

At the end of the 2 year period the flasks were carefully examined and then emptied. The pieces of metal were then very carefully cleaned, using first a hard toothbrush and kitchen cleansing powder, then using benzine and ether. Great care was taken to scrub the threads thoroughly to remove all foreign or organic material.

At the end of the experiment it was found that one of the flasks

had a grossly different appearance from the others, being quite thickly filled with a coarse white precipitate. On opening this flask, a very alcoholic aroma was noted and it was obvious that this flask had been contaminated with organisms in some way. The labels of two of the other flasks were found to have been eaten by some type of insect so that they were unintelligible. As may be noted from the table of results, there was one flask which showed a gross discrepancy and a marked weight loss, where all the others showed a weight gain. This discrepancy could not be accounted for, but it was felt to be so great as to be entirely out of line with the rest of the experiment. The results of all of the above mentioned flasks were not included in the computation of data of the experiment—namely, the one with the infection, the two with the labels destroyed,

CHART 1—VITALLIUM

| Number of Pieces | Initial Weight | Final Weight | Gain in Weight | Gm. |
|---------------------|-------------------|-----------------|-------------------|-----|
| | | | | Gm. |
| 2 | 0.9257 | 0.9258 | 0.0001 | |
| 2 | 0.9830 | 0.9851 | 0.0021 | |
| 1 | 0.5730 | 0.5743 | 0.0013 | |
| 1 | 0.5408 | 0.5419 | 0.0011 | |
| 1 | 0.6770 | 0.6791 | 0.0021 | |

There was a small amount of white precipitate, the serum was a light amber color, and the metal had the typical greyish appearance of new vitallium. These were observed in all the flasks except one, which was the second one listed above, and it appeared contaminated or infected. It contained a large amount of flocculent precipitate and had an alcoholic aroma.

and the one with the gross discrepancy. The general appearance of the various flasks was much the same in all the groups except those flasks containing the vanadium steel, where there was obviously much greater evidence of chemical activity. The general appearance in each group is described in the chart for the group. It was of interest that there was very little activity as far as the glass itself was concerned, except in the group with the vanadium steel where the steel had embedded itself into the glass and eroded it. A bottle of serum was used as a control and it was ordinary glass whereas the flasks used in the experiment were of pyrex. This control bottle showed a large amount of silica floating in the flask itself, whereas in the pyrex ones there was little or none to be seen.

CHART 2—TANTALUM

| Number of Pieces | Initial Weight | Final Weight | Gain in Weight |
|---------------------|-------------------|-----------------|-------------------|
| | Gm. | Gm. | Gm. |
| 2 | 2.5610 | 2.5627 | 0.0017 |
| 2 | 2.6147 | 2.6163 | 0.0016 |
| 1 | 1.5876 | 1.5966 | 0.0090 |
| 1 | 1.4146 | 1.4230 | 0.0084 |
| 1 | 1.8288 | 1.8368 | 0.0080 |

All the flasks showed a small amount of white precipitate, the serum was a light amber color, and the tantalum had a dark appearance about like it had before it was placed in the serum.

CHART 3—18-8 STAINLESS STEEL

| Number of Pieces | Initial Weight | Final Weight | Gain in Weight | Loss in Weight |
|---------------------|-------------------|-----------------|-------------------|-------------------|
| | Gm. | Gm. | Gm. | Gm. |
| 2 | 1.1942 | 1.2035 | 0.0093 | |
| 1 | 0.6902 | 0.6924 | 0.0022 | |
| 1 | 0.7338 | 0.7349 | 0.0011 | |
| 1 | 0.7924 | 0.6946 | | 0.0978 |

All the flasks showed a small amount of white precipitate, the serum was a light amber color. The metal was bright and looked like it did before it was put in the serum, except in one flask, the last one in the list. In this flask the metal was slightly darkened and had lost considerable weight instead of gaining, as the metal in the other flasks did.

After thoroughly cleaning the pieces of metal they were weighed very carefully and their weights recorded. The question may be asked, why a detailed analysis of the fluid in the flasks was not done. It would undoubtedly have been of considerable value to attempt to isolate the various metallic elements from the serum, but this was impractical with the facilities at hand and could not be done. Instead, the only data obtained or obtainable was the weight of the metals themselves.

The data secured by weighing the metals before and after their period of two years soaking in human serum, are found on the

CHART 4—S. M. O. STAINLESS STEEL

| Number of Pieces | Initial Weight | Final Weight | Gain in Weight |
|---------------------|-------------------|-----------------|-------------------|
| | Gm. | Gm. | Gm. |
| 2 | 1.0457 | 1.0541 | 0.0084 |
| 2 | 1.0810 | 1.0902 | 0.0092 |
| 1 | 0.6110 | 0.6116 | 0.0006 |
| 1 | 0.6133 | 0.6135 | 0.0002 |

All the flasks showed a small amount of white precipitate, the serum was a light amber color and the metal was bright and looked like it did before it was soaked in the serum.

CHART 5—VANADIUM STEEL

| Number of Pieces | Initial Weight | Final Weight | Loss in Weight |
|---------------------|-------------------|-----------------|-------------------|
| | Gm. | Gm. | Gm. |
| 2 | 0.8837 | 0.8256 | 0.0581 |
| 2 | 0.9276 | 0.9208 | 0.0068 |
| 1 | 0.4382 | 0.4309 | 0.0073 |
| 1 | 0.4545 | 0.4529 | 0.0016 |
| 1 | 0.4952 | 0.4845 | 0.0107 |

There was a small to moderate amount of white precipitate in all the flasks except one, which showed a reddish precipitate. The serum in all was a dark amber and the metal was corroded and very dark in color. The screws were either stuck to the glass and imbedded in it or had marked the glass in all cases.

accompanying charts with each metal listed separately. On these charts the data are in actual weight loss in grams, carried out four places past the decimal point. The comparative figures of the various metals are consolidated on one chart and in this the data are presented as percentage of weight lost or gained, averaging the flasks in each group.

DISCUSSION

The data do not lead to very much concrete information. The vitallium and tantalum showed very similar weight gains and of roughly the same amounts. The 18-8 stainless steel and S.M.O. stainless steel were very similar in their behavior between them-

selves, but whereas the vitallium and tantalum had more weight gain in the flasks with one screw, the stainless steels showed more gain in the flasks containing two screws. No explanation has occurred to the authors for this.

CHART 6—CONSOLIDATED DATA
Various Metals Soaked in Serum for Two Years

| Metal | Weight Gain 2 Screws | Weight Gain 1 Screw | Weight Loss 2 Screws | Weight Loss 1 Screw |
|------------------------|-------------------------|------------------------|-------------------------|------------------------|
| Vitallium | 0.01% | 0.24% | | |
| Tantalum | 0.06% | 0.52% | | |
| 18-8 Stainless Steel | 0.77% | 0.22% | | |
| S.M.O. Stainless Steel | 0.83% | 0.06% | | |
| Vanadium Steel | | | 3.81% | 1.43% |

The question of why the vitallium, tantalum and stainless steels gained at all is not certain. The most reasonable explanation is that they were, for all practical purposes, completely inert and the gain was organic material stuck to the threads in the metal. However, in view of the great precautions taken to clean them thoroughly before weighing them, some chemical reaction leading to the weight gain is probable and certainly cannot be ruled out. Perhaps some compound was formed that could not be removed with cleaning.

The differences between the vitallium and tantalum were small and they may be considered of relatively the same order of inertness. The differences between the 18-8 and the S.M.O. stainless steels were so slight that they may be considered of the same degree of inertness. The difference between vitallium at one extreme and the S.M.O. stainless steel at the other is quite marked, nearing the order of one hundred times as much weight gain. If it might be assumed that the weight gain in all these inert alloys is an index of activity in serum then the order of inactivity would be vitallium, tantalum, 18-8 and S.M.O. when placed in human serum in pairs of pieces. Unfortunately, however, it cannot be proved that weight gain in this experiment was an index of activity. It is apparent, however, that vitallium, tantalum, 18-8 stainless steel and S.M.O. stainless steel are relatively quite inert when soaked in human serum.

As was anticipated from its appearance in bone, vanadium steel was very active chemically in the serum. It corroded grossly and had lost weight when weighed after cleaning. The amount of

weight lost was quite variable and inability to clean the corrosion off in the same degree in each instance, may have accounted for some of this discrepancy. The gross chemical activity as observed in the inert alloys and in the vanadium steel, was roughly comparable to the changes observed in the bone in clinical cases.

As stated earlier in this paper, this entire experiment was empirical. Nothing was definitely proved by it. Apparently Key's results in Ringer's solution were substantiated when the pieces of metal were soaked in human serum. The entire experiment was of interest and was thought-provoking, even though it was not of great concrete scientific value.

SUMMARY

Pieces of the metals used in bone and joint surgery were placed to soak for a period of 2 years in unaltered, sterile human serum at room temperature in pyrex flasks.

All the pieces gained at least a slight amount of weight. When placed in the flasks in pairs of pieces, vitallium gained the least amount of weight, then tantalum, 18-8 stainless steel, and S.M.O. stainless steel, in that order.

No very definite conclusions can be drawn from the experiment. It was simply an empirical one. The detailed results will be of interest to all those concerned with the reactivity of metals in bone.

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INTERINNOMINO-ABDOMINAL AMPUTATION OF THE LOWER EXTREMITY WITH INDICATIONS FOR THE EXTENSION OF ITS USE

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GORDON TAYLOR and Wiles, in a paper published in the British Journal of Surgery in April, 1935, gave a complete résumé of all published or reported cases of transiliac or interinnomino abdominal amputation of the lower extremity. Bilroth, in 1891 or 1889, was the first to perform the operation, but to Girard, in 1897, is given the credit for the first successful case. Pringle collected all cases and published his findings in the British Journal of Surgery in 1916. Gordon Taylor, in the British Journal of Surgery, April, 1940, reported an additional 6 cases, making a total of 11 cases operated upon by him alone, the largest series to date performed by any one individual. To date there have been 97 operations of this character performed. The largest cancer clinic in America at Memorial Hospital has reported a total of 7 cases. Undoubtedly there have been many more instances in which the operation would have been in the opinion of some indicated, but the formidable nature of the procedure, plus the assumed inevitability of a fatal outcome in the course of time in the type of cases under discussion, has, no doubt, deterred many from advising the procedure. King states that indications for such a radical amputation will always remain very limited and that over 90 per cent of the cases reported have been for malignant tumors affecting the proximal portion of the thigh, hip or innominate bone, so that disarticulation at the hip was impossible.

We are of the opinion that, when it is realized that the mortality rate can be kept low by judicious preoperative care and proper supportive measures during the operation, the indications for the operation can be greatly increased to include other malignant growths of the extremity further removed from the sites mentioned. It is a well known fact that many of the sarcomas of the thigh and leg have already extended to such heights on the limb that, though not macroscopically recognizable, they often eventuate in a recurrence after amputation or disarticulation.

We have also found lymphatics involved in these cases in the pelvis above any possible removal by disarticulation or classical amputation. We are definitely of the opinion that the indications for this type of operation should be increased to include such malig-

nancies as we have indicated, as our limited experience has invariably shown involvement of the pelvic lymphatics, even when the malignant process was below the knee. There are about 10 per cent more cases in which the operation is indicated, which include non-malignant conditions and injuries affecting the hip joint, upper femur and innominate bone.

We desire to report 2 cases of sarcoma of the lower extremity and one case of epithelioma of an amputated stump of the lower extremity of 4 years' duration, with metastases to the lymphatics of the pelvis.

CASE 1. C. P., a 14 year old white male, was seen at our Clinic on May 17, 1942, at which time he gave a history of having noticed for about 2 months a fusiform type of swelling about the middle of the right thigh, which had gradually increased in size. The patient gave a history of having received an injury to his leg about 9 months previously. He was in fair general condition. Heart and lungs were normal. No metastases were evident in the abdomen or lungs. The only symptom of which he complained was the fusiform type of swelling at the middle of the right thigh. There was very little tenderness, but the growth had shown a tendency to increase in size. The patient was advised to have a biopsy made and if malignancy was found to proceed with the radical transiliac amputation.

Upon incision of the tumor for biopsy it was found to be extremely vascular. The specimen removed showed it to be Rhabdo myosarcoma. The inguinal glands were enlarged and at operation the glands along the iliac vessels and aorta were found to be the site of metastases.

CASE 2. A. F., a colored male, aged 21, first noticed swelling about the middle of his left leg, midway between the knee and ankle in August, 1945. This was opened at one of the State institutions and he was told that he had an inflammatory condition. He was first seen at this Clinic on June 11, 1946, with a large, irregular, oval-shaped swelling involving the whole of the middle and upper third of his left leg between the knee and the ankle. He was emaciated and his general condition was poor. Prior to onset of this swelling, he gave a history of having had excellent health. He dates the onset of present illness from July, 1945, at which time he was thrown from a mule and afterward noticed marked swelling of the calf of his left leg. In August he went to one of our charity hospitals where he remained for a month. After returning home, his leg continued to swell and became more and more painful until he was unable to walk on it. In April, 1946, his home doctor removed a piece of tissue for biopsy and, upon getting a positive diagnosis of malignancy, referred him to us for treatment.

Upon operation this was found to be a small, round cell sarcoma with metastases as high up as the bifurcation of the common iliac artery.

It was necessary preoperatively to give this patient several blood transfusions in order to improve him as a surgical risk.

CASE 3. R. M., colored, aged 69, had had a compound fracture of his left leg 50 years previously and it had been amputated at that time. For 15 years he

had no trouble, then fell and injured the stump, but this finally healed and he had a very satisfactory stump for use with a peg leg. Four years prior to admission there developed an ulcer of the stump which had gradually encircled the whole surface of the stump. A biopsy of this showed it to be an epitheloma. There was present also enlargement of the inguinal glands and at operation one large metastatically involved gland was found along the external iliac.

These three patients all had an interinnomino abdominal amputation of the thigh performed. The type of incision varied slightly, but for all practical purposes was the same.

The incision was made extending from the posterior superior spine of the ileum to the anterior superior spine and from thence just above Poupart's ligament to just beyond the middle of the symphysis pubis. It will be noted that I have specified that the incision was made just above Poupart's ligament. Most operations that have been described have left Poupart's ligament intact because of its supportive nature in the closure of the operation. However, we feel that in doing so one transgresses one of the fundamental laws of cancer surgery—that is deliberately cutting across an infected field. All of the patients we have seen had definite involvement of the inguinal glands and any incision across this area would in all probability not have removed all of the malignant tissue. The skin was then dissected up, the attachments of the abdominal muscles to Poupart's ligament divided, the external iliac artery exposed, ligated and divided, the leg being put up so as to drain as much blood out of it as possible. After the division of the artery the external iliac vein was then ligated. This sequence is important, in that a large part of the blood in the limb will return directly back into the circulation if the artery is ligated prior to the ligation of the vein. The attachments of the rectus muscle and Poupart's ligament to the pubic bone were separated and the bone divided at its middle with a chisel and a hammer.

The perineal part of the operation extended down from the outer side of the pubic bone along the ramus of the pubic bone to the tuberosity of the ischium. Attachments of all muscles to the rami were freed with the periosteotome. There is at this point very free bleeding on account of the blood supply which enters the corpora cavernosum. All bleeding points are clamped and ligated as quickly as possible and the wound packed. The abdominal muscles are then separated from the crest of the ileum as far back as the posterior superior spine and the peritoneum dissected up gently over the iliac muscle until it is freed well up into the pelvic cavity. The bladder is retracted inward and the prostate and rectum freed from the overlying tissue. The spermatic cord, if not involved in the malig-

nant process, can be preserved by retracting it along with the bladder. Personally, I feel that there is real danger of leaving traces of malignancy in any effort to preserve the cord on the affected side. An incision is next made from the middle portion of the iliac crest vertically downward to the gluteal fold and following this fold around to the perineal wound and the tuberosity of the ischium. The gluteal muscles are freed and retracted, the pyriformis muscle divided and retracted, all bleeding points ligated. The posterior border of the ileum just lateral to its articulation with the sacrum is then divided with a chisel or Gigli saw, and traction made on the limb and ileum. This puts the psoas muscle on a stretch and it is also severed. The sciatic nerve is exposed as it enters the obturator foramen and is injected with 1 per cent novocain solution and divided. The limb is now removed, all bleeding points ligated and the wound closed by suturing the glutei and other muscles of the posterior flap to the muscles of the abdominal wall and rectus with interrupted mattress sutures of No. 2 catgut. A large penrose drain is usually introduced and the skin closed with mattress sutures of fine silk.

The anesthetic, we believe, plays an important part in the results obtained. In these three cases three different types of anesthesia were used. In the first, a young boy of 15 years, pentothal was used and he was transfused during the operation. There was considerable shock, but he made an excellent recovery and lived for approximately a year in good health—dying later of metastases to the lungs. In the second case the patient was 21 years of age and drop ether was the anesthetic of choice. He was given continuous transfusion during the operation, but developed marked shock. The third patient, aged 69, was given low spinal anesthesia consisting of 75 mg. of procain and 11 mg. of pontocain. This patient was also transfused throughout the operation and developed practically no shock. We believe that, taking all factors into consideration, the low spinal anesthesia probably carries less risk with it than either of the other types of anesthesia used.

One observation that was made by us is that in all of these cases there were definite metastases to the pelvic glands. In the first one extending upward along the aorta as many as possible were removed. In the second case they extended up as high as the common iliac vessel but we could not find any any higher. In the third case—that of an epithelioma—the metastatic process had invaded the pelvic glands along the whole course of the external iliac vessels but could not be demonstrated higher up. We feel that this observation alone is sufficient evidence to warrant the type of operation de-

scribed: by extending its use to embrace all malignancies which are far enough advanced to demand amputation or disarticulation at the hip have already reached a further extension of the metastatic process beyond the site of a classical amputation.

The operation is naturally of a mutilating type and one would from its character expect it to be attended by much shock. Therefore its successful completion necessitates careful preoperative preparation, particularly in the building up of the patient's strength, and the administration of blood transfusions. In the preparation of the patient every precaution should be taken to see that the lower bowel and bladder are completely emptied and also that all of the neighboring tissues have been given as thorough preparation as possible to render the field aseptic. During the operation we believe that continuous blood transfusion is one of the most important measures for the prevention of shock. In addition to this, gentleness in handling the tissues and rapidity in the execution of the operation are important factors in its success.

All of these patients made excellent recoveries—one lived for a year and, as I have said, died from metastases to the lungs. The other two as yet have shown no evidence of metastases involving other organs.

There have been to date, as stated earlier, 97 cases of operations of this character. In many it proved to be simply a palliative measure; some patients, however, have survived such an operation for years and remained in good health. It is our opinion that in these various types of malignancies, even when distant from the hip, most of them have already metastasized into the glands of the pelvis and that therefore this operation is the only measure that offers some patients the hope of permanent cure, and to the others palliation and relief from most of the undesirable sequelae suffered by victims of malignant diseases.

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SKELETAL TRACTION FOR FRACTURES OF THE HAND

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and

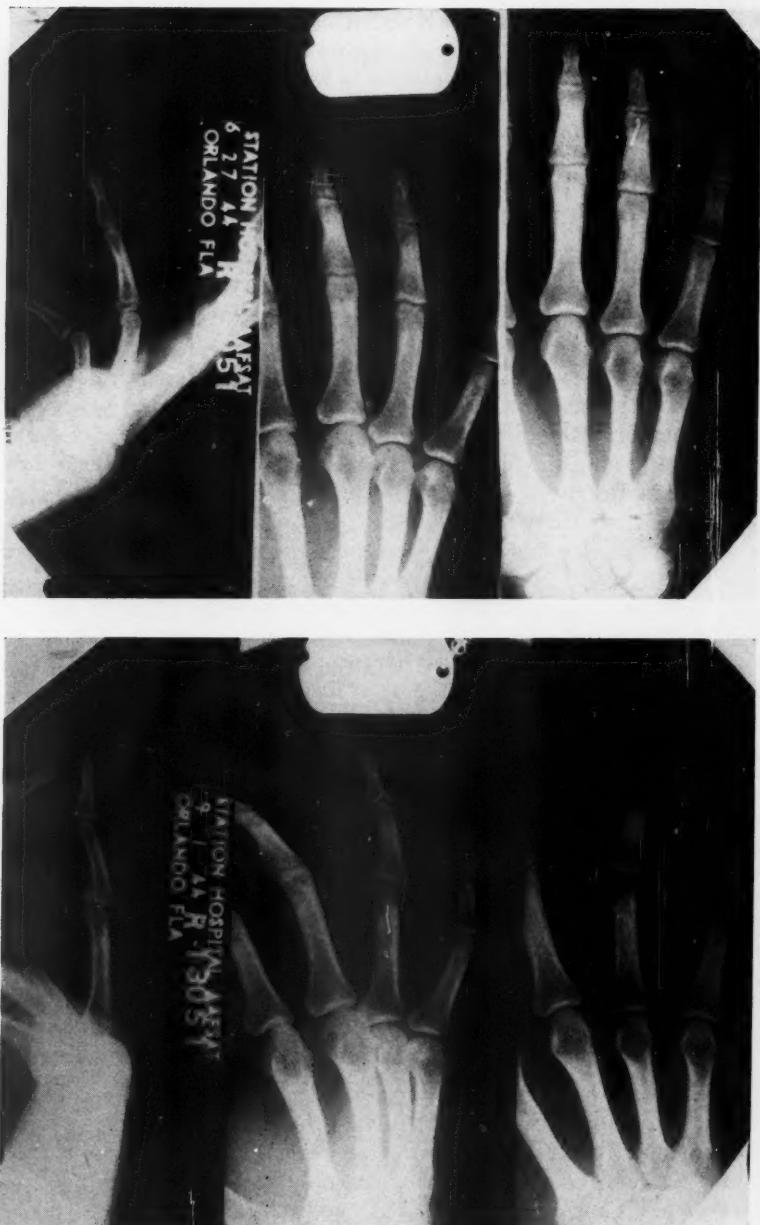
CAPTAIN JOSEPH R. DEITZ

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TRANSVERSE angulated fractures of the phalanges and metacarpals can be properly aligned by manipulation and immobilized in moulded plaster. Continuous skeletal traction in this instance is not necessary. It is necessary that the injured finger be immobilized in flexion to prevent stiffness of the metacarpophalangeal joint.¹ Many of the fractures about the hand where there is no gross displacement or instability of the joints may well be treated with a simple anatomic moulded plaster splint until the acute pain has subsided and early joint motion instituted within 3 or 4 days. Here it is mandatory that the patient be kept under close observation as secondary displacement may occur. It is a recognized fact that functional recovery will be hastened the shorter the period of immobilization required. Pain is probably the best index as to the advisability of allowing early motion in these undisplaced fractures. If this is sufficient to interfere with the motion of all fingers of the hand then the period of immobilization should be continued a little longer.

Excellent results have also been obtained in these non-weight-bearing fractures by procaine injections.² Working on the principle of active function during the period of fracture-healing, maintaining a normal blood supply hastens union. The conclusions of Ferguson and Erb² should be emphasized that only fractures which do not require reduction can be treated by this method. Still further, some cases that show no displacement on the original examination may actually become displaced on active use. This is especially true of those fractures extending into joints due to the degree of capsular damage (figs. 1 and 2). Frequent follow-up examinations by x-ray are necessary to prevent this complication.

It has been exhibited repeatedly that those fractures of an oblique nature, comminuted, and particularly those extending into a joint, do not give the best results when simply immobilized without traction. Skeletal traction will keep the oblique and comminuted fractures pulled out to a normal length and prevent them from uniting in a short position (figs. 3, 4 and 5). In the long oblique fractures of the metacarpals it is not uncommon for the shortening to in-



Figs. 1 & 2. Undisplaced fracture, middle phalanx of right ring finger that displaced on active use while not under observation.



Fig. 3

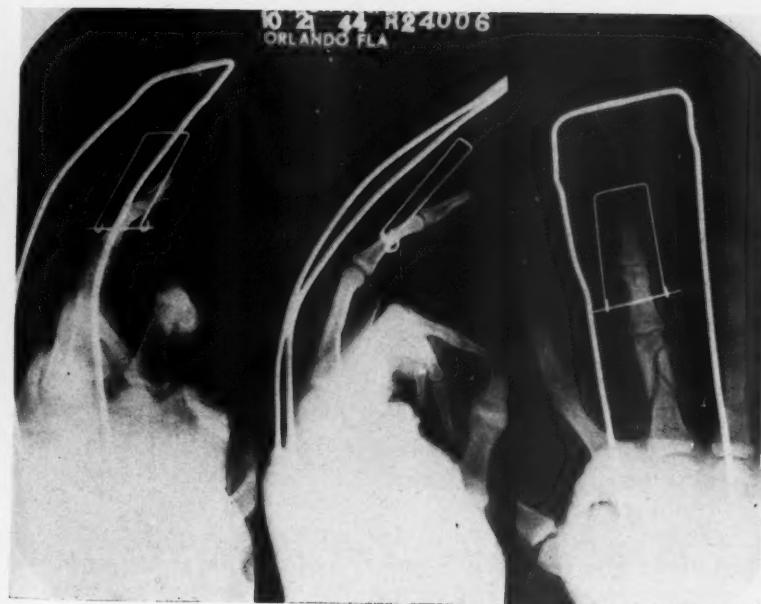


Fig. 4



Fig. 5

Figs. 3, 4 & 5. Traction for comminuted fracture proximal phalanx left middle finger. Union in 21 days. Note old deformity of shaft of 2nd metacarpal with shortening and depression of head into palm from poorly treated fracture.

crease during treatment unless constant traction is utilized to overcome the normal muscle pull. Coby et al³ have stated well the advantages of skeletal traction over skin traction, and it is agreed that the maintenance of any reduction is very uncertain with other than skeletal traction.

A method of traction which fulfills all principles of traction is the use of a Kirschner wire through the phalanx as close to the fracture site as possible. Previous to the insertion of the wire the extremity is cleansed thoroughly with soap and water and prepared in the accepted manner. One per cent novocaine is infiltrated into the pin sites, or a regional local block may be performed. On certain occasions where manipulation of the fracture is desired, novocaine infiltration into the fracture site may also be performed. It is an advantage to use a drill which allows the Kirschner wire to protrude only a short distance for better control. Following insertion of the wire the remaining portion of the wire is fashioned into a proper traction loop and arranged so that the loop rotates easily about the pin (fig. 4). This is in contrast to the commercial trac-



Figs. 6 & 7. Showing convenient arrangement of traction loop to allow wearing of clothing. Fig. 7 also shows direction of pull and point of fingers to tuberosity of the scaphoid.



Figs. 8 & 9. Oblique fracture shaft of 5th metacarpal. Motion can be encouraged as the traction loop rotates about the pin through the phalanx which remains at rest.



Fig. 10



Fig. 11



Fig. 12

Figs. 10, 11, 12. Oblique fracture proximal phalanx index finger. Fig. 11 shows method of leaving Kirschner wire in place and instituting early motion. Traction may be resumed if necessary.

tion bows on the market which screw down on the wire and where motion of the part eventually leads to rotation of the Kirschner wire through the bone. Any arrangements required of a traction loop may be made with a wire coat hanger but an effort should be made to keep this as convenient as possible for the wearing of clothing. The plaster cast used to support the traction should extend to the base of the metacarpals on the dorsum and, unless actually needed in the support of the fracture, trimmed back on the volar surface to the proximal palmar crease (figs. 6 and 7).

A traction pin that passes through the soft tissues alone does not have sufficient resistance to prevent motion if the normal or free fingers are allowed to move (figs. 8 and 9). A pin which traverses the bone is quite stable and permits any desired strength of traction. Absolute rest of the traction pin in the bone is essential in the prevention of infection. A pin that rotates or slides is usually the one that becomes infected.⁴ This complication may be prevented by using the remaining portion of the Kirschner wire and arranging the loops so that they rotate easily about the fixed



Fig. 13



Fig. 14



Fig. 15

Figs. 13, 14, 15. Skeletal traction on oblique fracture 4th metacarpal prevents recession of head and preserves mechanics of hand.

portion of the Kirschner wire through the bone. Continuous traction is maintained with rubber band traction and here the cuff of a discarded surgical glove is most useful. Hanby, et al, in their experiments with rubber band traction, showed that the cuffs of discarded size 7½ surgical gloves gave the most uniform weight traction results and that a stretch of three and one-half inches gave a two and one-half pound pull and when this stretch was increased to seven inches there was a five and one-half pound pull.⁵

Kennedy⁶ has advocated traction that pulls through the bone involved rather than through one or more joints distal to the site of fracture and prefers traction through the metacarpal for fracture of the shaft of this bone. This is technically difficult except in certain cases of fractures of the first metacarpal. It is agreed that traction through the proximal phalanx is superior to traction through the terminal phalanx. Traction through the metacarpophalangeal joint in our experience has shown no undesirable results. It may in fact be desirable in a swollen hand for, as Bunnell has stated: "This traction has the additional advantage of keeping the collateral ligaments of the proximal phalanx joint drawn out long."¹

The period of immobilization for these fractures of the hand has averaged 21 days. Not much callus is evident at the end of this time and the fracture site is still visible but active motion is usually safe. In some instances the time of traction immobilization has been decreased to less than 21 days. Here (as in fig. 11) the traction pin is left in place after removal of the traction bar and active motion instituted. It is a simple procedure to resume traction should any loss of alignment occur.

FRACTURES OF THE PHALANGES AND METACARPALS
TREATED FROM JULY 1, 1943, TO JAN. 1, 1945

| | <i>Simple</i> | <i>Comminuted</i> | <i>Compound</i> | <i>Total</i> |
|-------------|---------------|-------------------|-----------------|--------------|
| Phalanges | 44 | 12 | 26 | 82-60% |
| Metacarpals | 44 | 5 | 4 | 53-40% |
| | | | | 135 |

FRACTURES OF THE PHALANGES AND METATARSALS
TREATED BY SKELETAL TRACTION

| | <i>Simple</i> | <i>Comminuted</i> | <i>Compound</i> | <i>Total</i> |
|-------------|---------------|-------------------|-----------------|--------------|
| Phalanges | 10 | 5 | 2 | 17-12% |
| Metatarsals | 16 | 4 | 2 | 22-16% |
| | | | | 39-28% |

One hundred and thirty-five fractures of the phalanges and metacarpals have been treated from July 1, 1943, to Jan. 1, 1945. Of this number 39, or 28 per cent, were treated by the skeletal traction method as described above. Of this number there were no complications of bone or skin infections about the pins. Traction has not been used in any fracture where it was reasonably certain that the position of reduction could be maintained by simple immobilization. Four of the 39 displaced fractures treated were compound and 2 of these the result of gunshot wounds through the hand, with marked comminution of the 2nd and 3rd metacarpals. By maintaining proper length of the metacarpals during the healing period these cases united with good length of the metacarpals and resulted in very useful hands. Following the removal of the traction and Kirschner wire, the skin wounds healed within 3 or 4 days. Following healing, whirlpool and massage were given and normal range of motion of the involved joints of the hand was restored in from 3 to 5 weeks. It has been our experience with the traction method in the treatment of fractures extending into the joints of

the fingers the final range of motion was greater than in those treated by simple immobilization.

CONCLUSION

Traction with a Kirschner wire in displaced fractures of the phalanges and metacarpals was found to be quite safe and useful in obtaining union in correct alignment and length. This form of traction has fulfilled the three main requirements of skeletal traction:

1. Traction must be regulated, continuous, and with the finger in flexion. The line of the finger must point to the tubercle of scaphoid.
2. There should be no motion between the osseous tissue or soft tissue and the material used for traction.
3. Free motion of the joints of the hand not actually involved in traction must be maintained.

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THE SPREAD OF CARCINOMA OF THE STOMACH

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THE frequency of carcinoma of the stomach and resultant death warrants a study of the steps by which the malignancy spreads. An understanding of the progress of the disease is prerequisite to intelligent treatment.

Cancer in general is spread in three ways:

1. By direct extension;
2. By lymphatics; and
3. By blood stream.

The spread of carcinoma by direct extension is possible in any direction; in general, it spreads in the lines of least resistance. Thus, paths of extension may be limited by any dense planes of tissue. Structures which perforate these natural planes of resistance also allow malignant cells to grow along their sides. Cancer of the stomach may spread first within the stomach wall and then spread out along any of the structures which support the stomach. The gastrohepatic ligament is noteworthy in the spread of cancer of the stomach, and along this plane direct spread into the liver is relatively easy. Cancer of the stomach may also spread by "seeding" to other viscera in the peritoneal cavity.

The anatomy of lymphatic drainage of the stomach is of interest. It will be noted that the intrinsic lymphatic vessels of the stomach drain in three directions, all of which drain to the preaortic nodes around the celiac artery, and from there drain into the thoracic duct (fig. 1). Lymphatic vessels on the lesser curvature drain to the superior gastric chain of nodes lying between the folds of the gastrohepatic ligaments. This is the most important group of nodes draining the stomach and it has been shown that the direction of flow of lymph is across to the left, or to the cardiac end of the stomach from where the flow goes on to the celiac nodes. Lymphatics of the greater curvature empty into the inferior gastric nodes and from there reach the subpyloric nodes, and from there reach the celiac nodes. There is no record of lymphatic drainage toward the liver; rather, the lymph nodes in the gastrohepatic ligament around the common bile duct drain to the superior gastric chain. And metastases of carcinoma of the stomach reach the thoracic duct via the preaortic chain of nodes. From the thoracic duct the systemic blood stream may be reached, since the thoracic duct discharges into the left subclavian vein.

The blood supply to the stomach is through two richly anastomotic loops, one on the greater curvature, the other on the lesser curvature. The celiac trunk trifurcates almost immediately after leaving the abdominal aorta into three branches: the left gastric, the splenic, and the hepatic artery. The right gastric artery from the hepatic artery anastomoses with the left gastric artery to supply the lesser curvature. The greater curvature is supplied by the

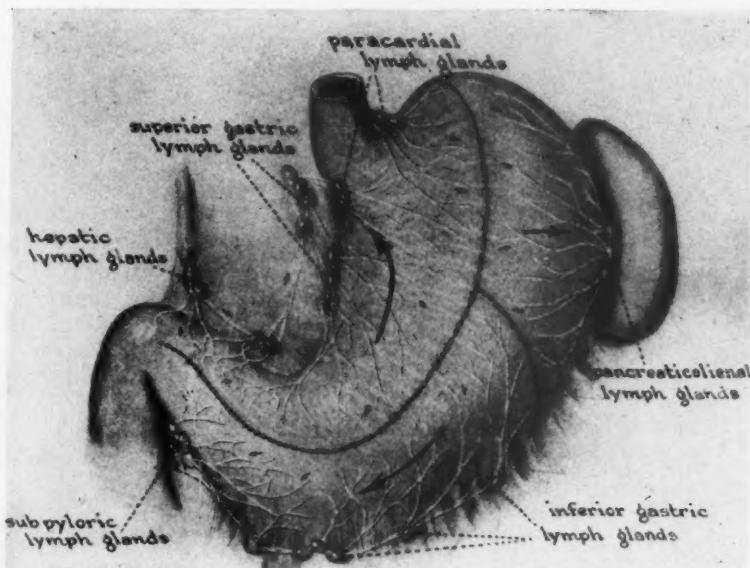


Fig. 1. Lymphatics of the stomach. (From Babcock: "Principles and Practice of Surgery." Philadelphia: Lea & Febiger, Publishers, 1944.)

gastroepiploic arteries, the right arising from the gastroduodenal, the left from the splenic artery. Short gastric arteries from the splenic artery supply the fundus of the stomach.

Veins of the stomach follow essentially the same pattern as the arteries; they empty into the large splenic and superior mesenteric trunks of the portal vein, or into the portal vein itself. The left gastric vein is a tributary of the portal system; it anastomoses, however, with the esophageal veins which empty into the azygos vein, a tributary of the vena cava.

Erosion of gastric carcinoma into a vein results in liver metastasis. Erosion into an artery may result in distant metastasis because of the anastomotic arterial arrangement; systemic blood stream metastasis, however, is much more likely to take place via

lymphatic drainage through the thoracic duct to the subclavian vein, as already outlined.

Secondary liver carcinoma is relatively frequent, the growth reaching the liver either by direct extension, or by way of the portal

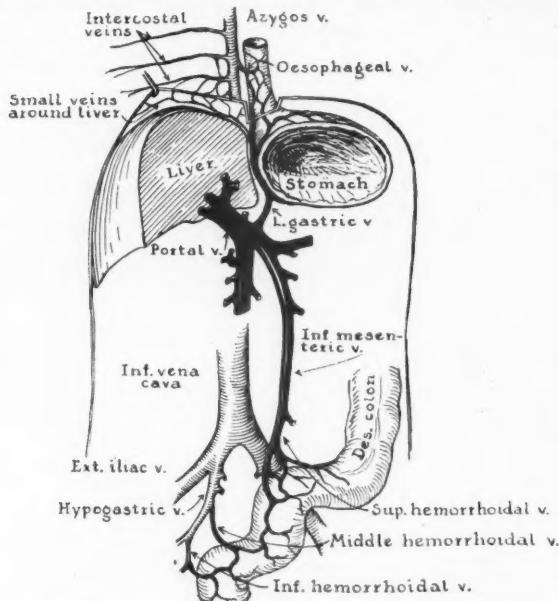


Fig. 2. Anastomotic channels by which blood may by-pass the liver.

veins; the latter is probably more frequent. Carcinoma of the liver then begins to grow around the portal triads in the liver, thus causing portal vein obstruction, ascites, or jaundice. To understand the symptoms of portal vein obstruction it is necessary to review the anatomy of the portal system.

Venous blood below the diaphragm is returned to the heart by either the caval system or by the portal system. The portal vein is a thick trunk about 7.5 cm. long formed behind the head of the pancreas by the union of the splenic and superior mesenteric veins. It collects blood from the whole abdominal alimentary tube, the pancreas, and the gallbladder. This blood is taken through the liver, screened out, and then picked up by the hepatic veins to reach the vena cava. The inferior vena cava, arising from the confluence of the two common iliac veins, ascends to the heart in close relationship to the abdominal aorta; it receives venous blood from the body wall, from the lower extremities, and from those veins of the

abdominal and pelvic cavities which are not tributaries of the portal system.

When there is portal vein obstruction, collateral circulation is brought into play to allow venous blood to bypass the liver. This is possible through the following pathways:

1. Para-umbilical veins of the portal system run through the falciform ligament to anastomose with epigastric veins of the caval system. From this anastomotic loop the "Caput medusae" around the umbilicus may be seen when there is portal obstruction (fig. 3).

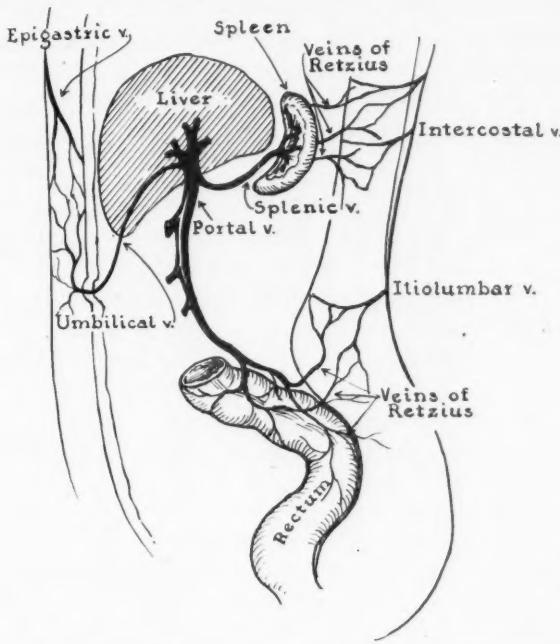


Fig. 3. Anastomotic channels by which blood may by-pass the liver.

2. The left gastric veins anastomose with esophageal veins which drain into azygous veins, which drain into the vena cava. When the esophageal veins are enlarged they are easily ruptured, and therefore esophageal hemorrhage is not uncommon in portal vein obstruction (fig. 2).

3. Superior hemorrhoidal veins of the portal system anastomose with middle and inferior hemorrhoidal veins of the caval system (fig. 2).

4. Small veins in the lesser peritoneal cavity which drain into the

portal system anastomose with diaphragmatic and intercostal veins of the caval system (fig. 2).

5. Veins of Retzius (plexuses of veins in retroperitoneal spaces which drain viscera which have certain parts in retroperitoneal spaces) anastomose with branches of the caval system (fig. 3).

CARCINOMA OF STOMACH

Inoperability indicated by presence of —

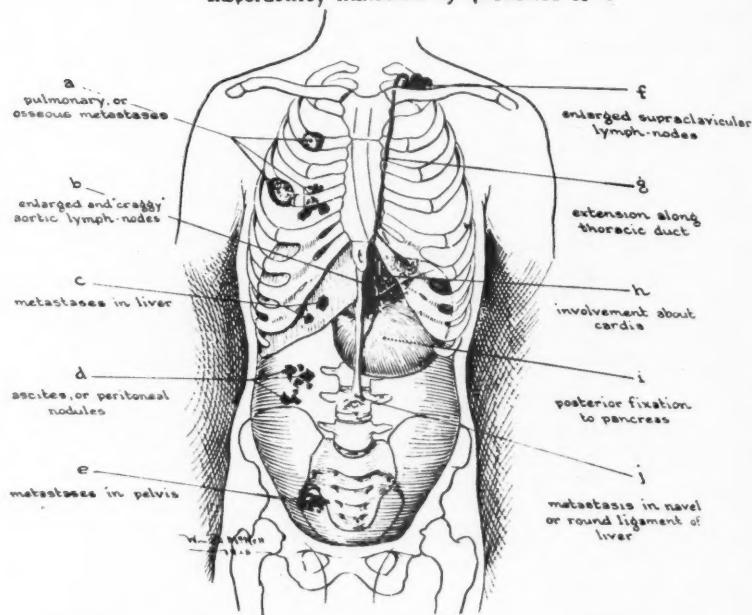


Fig. 4. Sites of secondary carcinoma from carcinoma of the stomach. (From Babcock: "Principles and Practice of Surgery." Philadelphia: Lea & Febiger, Publishers, 1944.)

When there is portal obstruction there is usually a collection of fluid in the peritoneal cavity. This may suggest that the circulation afforded by the collateral system is not sufficient to compensate for the obstruction, or that the portal obstruction effects a change in liver metabolism causing an alteration of normal balance of body fluids.

Another significance of the collateral circulation is that in portal vein obstruction due to cancer, subsequent malignant cells entering the veins of the stomach may find their way through the collateral circulation to lodge in some point along the way to the vena cava.

The discussion to this point will explain the mechanism of metas-

tases to points as illustrated in Figure 4; Babcock's "Principles and Practice of Surgery" presents this diagram to enumerate common metastatic areas of carcinoma of the stomach, any of which, if found, denotes inoperability of the stomach.

- a. Pulmonary or osseous metastasis is by way of systemic blood stream invasion, usually via the thoracic duct.
- b. Enlarged and craggy aortic lymph nodes from lymphatic invasion from the stomach.
- c. Metastases in the liver by direct extension or by way of the portal vein.
- d. Ascites, because of portal vein obstruction.
- e. Peritoneal nodules and metastases in pelvis, from "seeding" into the peritoneal cavity, or from systemic blood stream invasion.
- f. Enlarged supraclavicular lymph nodes, from invasion of the thoracic duct.
- g. Extension along the thoracic duct.
- h. Involvement about the cardia of the stomach, by extension along the lymphatics.
- i. Posterior fixation to pancreas, by direct extension.
- j. Metastases in navel or round ligament of liver by way of the paraumbilical veins when there is portal vein obstruction.

SUMMARY

In this paper, the sites of secondary carcinoma from carcinoma of the stomach are studied in order that an intelligent evaluation of operability of early cancer of the stomach may be made, and that directions of local spread are realized when radical resection of stomach cancer is undertaken.

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SPONTANEOUS RUPTURE OF THE UTERUS

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SPONTANEOUS rupture of the uterus is one of the most serious complications of pregnancy for both mother and child, and one of the cases herein reported is unique in that a search of medical literature fails to reveal a comparable case. We saw one of the patients because of the abdominal findings complicating the rupture of the uterus. The second case illustrates a condition in which rupture of the uterus can be present for a long period of time, without the dramatic and serious symptomatology usually thought of in cases of uterine rupture, and still deliver a viable child. The cases are of especial interest because in one the complication occurred in a primigravida at approximately 4½ months' gestation, and the second patient was delivered of a living child though the fetus had been extruded completely into the peritoneum.

CASE 1. This 29 year old colored female entered the hospital on Oct. 24, 1944, complaining of intermittent abdominal pains of eight weeks' duration. The pain had begun as a steady epigastric discomfort "like a knot just below the breast bone." This was associated with nausea and vomiting, which lasted two weeks. She had then begun having cramping pains in the lower abdomen which she described as "like labor pains." Two weeks after onset of illness, she was admitted to another hospital where she was told she had a "tumor." One week later, a rupture in the abdominal wall occurred approximately one half inch above the umbilicus, and about one gallon of thin, greenish material immediately drained from the site of rupture. Two weeks later the drainage began to look and smell like fecal material. She had not had a normal bowel movement in three weeks prior to admission to Frasier-Ellis Hospital. She had had a constant and high fever, her appetite had been poor and since the onset of her present illness, weight loss had been extreme and rapid. Three days prior to her admission here, the hand and lower arm of the fetus was noted to be protruding through the abdominal wall just above the umbilicus. Her last menstrual period had been in July, 1944. She had had no previous pregnancies. Her past history and family history was noncontributory except for some vaginal discharge and chronic discomfort in the lower abdomen.

On physical examination, she was noted to be a poorly developed and nourished colored female, extremely emaciated and dehydrated, with a very dry skin lacking turgor. She was practically moribund. The head, ears, nose and eyes were essentially negative and the teeth were covered with sordes. The thorax was symmetrical and had fair but equal bilateral expansion, and the

lungs were clear and resonant. The heart rate was rapid with a slapping first sound. The heart was in normal position and no cardiac enlargement or murmurs were heard. The abdomen was moderately rounded and its external surface was covered with a fecal-like material. There were three sinuses about the umbilicus, two of which were draining fecal-like material, and from the third sinus, a fetal arm from the elbow down protruded (fig. 1). The soft tissue of the arm was macerated and some had sloughed off exposing the radius, ulna, metacarpal and phalangeal bones. The patient's abdomen was rigid and there was a generalized tenderness over the entire abdomen but more severe in the lower portion. No other fetal parts could be palpated. On vaginal examination, the cervix was firmly fixed, nulliparous in character, and with foul discharge at the external os; both fornices were board-like in rigidity (a



Fig. 1

frozen pelvis), and the details regarding the uterus and its contents were difficult to determine because of the abdominal tenderness. The rectum was filled with feces but no intrinsic lesions were present. The extremities were essentially negative except for dehydration and emaciation.

The laboratory work showed her to have a positive Kahn, a hemoglobin of 22 per cent, red blood count of 1,950,000 with a marked pallor of cells, anisocytosis and poikilocytes, a white blood count of 10,000 with a slight shift to the left in the Schilling Hemogram. She was a type AB. The urine was essentially negative. X-ray examination of abdomen showed the intestines to be distended with gas, and located in approximately the mid-abdomen were distorted fetal bones with some overlapping of the cranial bones which were located in the pelvis (fig. 2).

The day following admission, she was given 1000 c.c. of whole blood; on her second hospital day another 1000 c.c. followed by a third transfusion of 500 c.c. the following day. This 2500 c.c. of whole blood raised her hemoglobin to 70 per cent, red blood cells to 3,650,000 and her white blood count had dropped to 8,200 and the Schilling Hemogram was normal. Intravenous

glucose and saline had been given in large quantities. On November 7 (13th hospital day) she was operated upon and the following findings noted: The abdomen was opened by a midline incision extending toward the symphysis from area of sinus tracts. The anterior abdominal wall was gangrenous and sloughing. The fetus (fig. 3) was partially inside the uterus with the head in position in the lower uterine segment. In addition to the fetus, the uterus

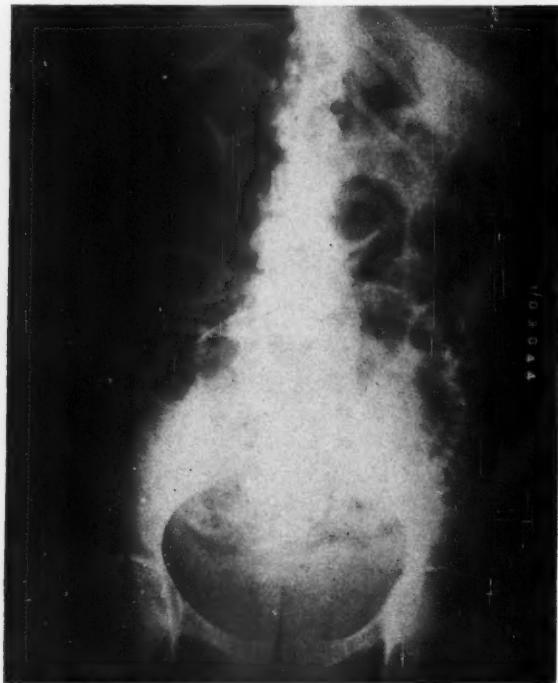


Fig. 2

was filled by a brownish-red, foul smelling exudate. This was removed by suction and it could then be made out that the anterior portion of the fundus of the uterine wall had sloughed away and the endometrium of the entire uterus was absent exposing the myometrium. This presented a dry appearance and the branching bundles of muscle could be clearly made out. The lower uterine segment and peritoneum in this position had sloughed leaving the heavy brim of the true pelvis, covered only by periosteum, exposed. The head of the macerated fetus was in this position. The fetus was removed, exudate sucked out, and a Babcock "sump tube" placed in the pelvis and connected to a suction pump, leaving the wound open. At no time during the procedure were bowel, ureters, or blood vessels seen.

Following operation the intravenous fluids were continued and two transfusions of blood in 1000 c.c. and 500 c.c. quantities were given. The wound drained profusely and 27 days following the operation the patient died as the result of sepsis, avitaminosis and malnutrition. No autopsy was performed.

CASE 2. This 37 year old gravida IV, para III, white female was admitted to the hospital on Feb. 4, 1946, complaining of intermittent cramping abdominal pains of approximately 12 hours' duration. She was known to be pregnant and had been given prenatal care for approximately $5\frac{1}{2}$ months prior to hospital admission. Her last menstrual period had been May 12, 1945. Nausea had been moderately severe through June and had never completely subsided. In addition to the nausea, some dyspepsia and moderate constipation had been present. She had had frequent attacks of cramping abdominal pains during the prenatal period, some of which required narcotics and one attack



Fig. 3

required hospitalization. No other symptoms were present during these bouts of pain. She had had no fainting attacks and no severe abdominal pain. Her past history, menstrual history, and family history was noncontributory. She had given birth to one premature stillborn and two normal siblings, the last $2\frac{1}{2}$ years previously.

On physical examination she was noted to be a well developed and nourished, pregnant white female at term, having cramping abdominal pains. The head, ears, nose, eyes, and mouth were essentially negative and the thyroid was not palpable. The thorax was symmetrical and had good and equal bilateral expansion. The lungs were clear and resonant with no rales or rhonchi. The heart was of normal size and no thrills or murmurs were present. The blood pressure was 120/80. The pulse rate was slow and regular. The abdomen was markedly distended and the fetal soft parts could be readily palpated but no definite identification of head or buttocks could be made. The fetal heart tones were good. On pelvic examination the perineum was found relaxed, grade 2, the cervix was cystic but not eroded, soft and non-patulous and located high in the pelvis. No additional information as to position of fetus could be made out. The extremities were essentially normal.

The laboratory findings were as follows: Red blood cells 3,700,000, hemoglobin 69 per cent, and the white blood cells 10,400, with a slight shift to the left in Schilling Hemogram. A trace of albumin, a few hyaline casts and 1 to 2 white cells per HPF found in the urine. She was a type B. Her Kahn

was negative and her stools showed no parasites, ova, or blood. X-ray examination (fig. 4) showed a full term fetus with the head high up under the right diaphragm and right rib margin, the back arching across under the diaphragm with the sacrum beneath the left diaphragm. One leg was seen to be extending downward toward the pelvis from the left. The lower abdomen did not contain any portion of the fetus.



Fig. 4

From the x-ray findings above, it was thought that the position of the fetus might be due to some lesion such as ovarian pathology displacing the uterus and fetus upward, or that an extrauterine pregnancy was present. Due to the poor uterine contractions, pituitrin was given. This resulted in no improvement in the situation and cesarean section was advised. She was given 500 c.c. of whole blood on February 7 and again on the 8th and under gas-oxygen-ether anesthesia, she was operated on February 8. At operation, and on entry into the peritoneal cavity, approximately 5000 c.c. of greenish fluid was found. The rather large fetus was found lying completely in the peritoneal cavity and the placenta was noted to be attached to the ruptured fundus of the uterus which was in an everted state. The peritoneum, especially in the region of the uterus and bladder, was covered by a thick, greenish exudate and was itself thick and friable. The small bowel was greatly distended. A supravaginal hysterectomy, bilateral salpingectomy and right oophorectomy was done. Her condition at the completion of the operation was very poor and she was given another 500 c.c. of whole blood. The fetus was living and in good condition.

The patient never completely recovered from the operative trauma and she died approximately 18 hours following surgery from surgical shock and peritonitis.

Pathologic study of uterus and placenta was noncontributory as to the possible etiology of this fundic rupture of the uterus.

COMMENTS

According to Guerrigues,⁶ rupture of the uterus in America is less frequent than in Europe and this may be attributed to several factors such as less pelvic distortion due to rickets and osteomalacia and more medical supervision in obstetrics. Table I shows the incidence as reported from various obstetrical services in this country and abroad:¹⁷

TABLE I

| Series | Type During Labor | Spontaneous | No. of Cases | Percentage |
|-------------------------------------|----------------------|-------------|----------------|------------|
| Bandl | Not given | | 19 in 46,614 | 0.040 |
| Baxan & Uranga | | | | |
| Imaz | Not given | | 21 in 227,500 | 0.070 |
| Collins | Not given | | 34 in 216,414 | 0.015 |
| Ivahoff | Not given | | 124 in 118,581 | 0.105 |
| Frid | 43 | 7 | 50 in 37,898 | 0.131 |
| Cabrae | 22 | 2 | 24 in 20,500 | 0.120 |
| Los Angeles Co. General Hospital | | | 30 in 17,350 | 0.172 |
| Dugger, John H. ⁹ | 59 | 56 | 105 in 318,103 | 0.033 |

From this table it is evident that the incidence of this complication as reported in large obstetrical centers varies greatly and ranges from 1 in 95²⁴ to 1 in 4000 deliveries. Few cases of uterine rupture prior to onset of labor have been reported but Baisch² in 1903 collected 78 such cases and added one of his own. Of these 79 cases, 31 occurred during the first 5 months of gestation. DeLee⁷ in 1904 and Kane¹² in 1923 reported one case each of rupture prior to onset of labor and without trauma as an antecedent. Schenck and Radar¹⁸ reported a case which occurred at 3½ months' gestation at the site of the amputation of a uterine tube at a previous operation. Warfield²² reported a case which had had a previous abdominal pregnancy proved at laparotomy. Milnor¹⁵ reported a case in late pregnancy and speculates that the cause might have been sudden and violent movements of the fetus which in turn caused a violent contraction of the uterus. Alexander¹ reported a rupture of the

uterus at 4 months' gestation due to "hypoplasia of Myometrium." Rupture does occur before the onset of labor but it is rare; however, many cases are accumulating in the world literature.^{3,4,14,16,23}

No effort will be made to review the complete list of etiologic factors in rupture of the uterus, but it should be mentioned that rupture following cesarean section, especially one of the classical type, is frequent when studied statistically.⁵ We are seeing more and more myomectomies, and in larger series of cases of rupture of the uterus, this procedure also ranks high in the list of predisposing causes for rupture. It is felt that when more than a pedunculated myomata is excised from the uterus, the patient, on becoming pregnant at a later date, should be followed as closely as if she had had a cesarean section. Improperly and energetically performed curettements fall into the same category.

In one of the cases presented, there existed the history of previous pelvic infection. This is one of the important predisposing causes to uterine rupture. Lohlein was the first to call attention to this etiologic factor, and this has been confirmed by many other well controlled microscopic studies of uteri removed either at operation or postmortem.^{10,18,19} The findings are those of chronic infection such as lymphocytic, monocytic, and plasma cell infiltrations into the myometrium and the increased amount of fibrous tissue in the uterine wall. There is frequently a hyalinization of blood vessel walls and muscle fibers. The end result is a uterus much less able to undergo the changes necessary in a pregnancy and the process of expelling the fetus. Patients with a history of a previous uterine infection, whether following abortion, miscarriage, or term parturition, warrant close observation during subsequent pregnancies and deliveries because of the possibility of uterine rupture.

Rupture of the uterus which occurs before the onset of labor are usually located in the fundus, whereas those occurring during labor are more often in the lower uterine segment. Perez,¹⁷ however, in his series of 11 cases, states that 7 occurred in the lower uterine segment, and Delps and Eastman⁸ report 12 of 77 cases occurring in the lower uterine segment. Gordon and Rosenthal,¹¹ in analyzing 30 maternal deaths due to ruptured uteri, found 28 cases involving the lower segment. Four of their cases involved both segments of the uterus. Individual experiences vary but the general statement is the more prevalent; however, as indicated above, this is not sustained by statistics. One of our patients had a rupture in the fundus of the uterus with complete extrusion of the fetus into the abdomen. The other apparently had a fundic rupture, though so many changes due to infection had occurred that the original pathology is difficult

to state with certainty. Though this was true, neither had ever had any evidence of shock. D'Acierno⁵ quoted Kreisch's experience with a case in which both an eight month fetus and the placenta had slipped through a rupture of the uterus into the abdominal cavity, but the condition was not recognized for 12 days as there was comparatively little hemorrhage. In his case, as in ours, sepsis developed. His was corrected by laparotomy. In one of the cases herein presented, sepsis in the form of peritonitis, edometritis, metritis, and perimetritis developed and led to an erosion and sloughing of the anterior abdominal wall in an effort to extrude the contained foreign body and rid the peritoneum of the purulent material similar to that seen in other conditions such as the development of intestinal fistulas in regional ileitis, diverticulitis, etc. This resulted from neglect. In our cases, sepsis was too much for the patients and death ensued. Thomas²⁰ reported a case in which there was a rupture of the rectus abdominis muscle during late pregnancy and Uno²¹ reported one of rupture of the anterior abdominal wall and of uterine cicatrix at term. Uno's case is the nearest to Case 1 of this report found in the literature.

In all analyses of spontaneous rupture of the uterus, all patients were multiparae with an average of 4 to 6 siblings in the various groups reported. One of our patients was multiparous, having given birth to 3 children. The other patient was a primigravida. The signs and symptoms in order of frequency are bleeding, severe pain, abdominal tenderness, cessation of labor, shock, pallor, change in position of fetus, syncope, blood in the urine, and distention. Two of these are of especial interest. The cessation of labor is frequently thought to be uterine inertia and oxytocins are frequently given.²³ We were guilty of this mistake in one of our patients. The patient was given pituitrin. This simply delays the proper treatment. It should be emphasized that only approximately 50 per cent of cases have symptoms of shock and 20 per cent have much abdominal tenderness. Schroeder reports 7 of 63 cases who had no symptoms at all. Thus, when labor rather abruptly ceases, it is well to keep in mind the possibility of rupture of the uterus. Delps and Eastman⁶ report blood in the urine in 100 per cent of rupture of the uterus and attribute this to strain on the bladder wall causing disruption of the bladder mucosa with consequent bleeding. With a rather abrupt cessation of labor, tenderness in the abdomen and blood in the urine, we believe one is justified in treating the case as one of uterine rupture.

Though Dugger⁹ in the study of 105 cases lists numerous obstetrical procedures, such as spontaneous delivery, low and high for-

ceps, etc., we believe that laparotomy is the procedure of choice for only through this route can hemorrhage be adequately controlled, a higher percentage of live infants be born, and, in cases where the wound is clean and not too traumatized, can the uterus be repaired and, in the other cases, hysterectomies carried out. In cases in which shock is present, of course the blood volume must be corrected preferably through transfusions of whole blood and, in instances where this is not immediately available, plasma. Adequate amounts must be given and this frequently requires huge quantities.

In cases of complete rupture of the uterus, infection is second only to shock due to blood loss in the causes of maternal death. This manifests itself in the form of metritis and peritonitis. Maternal death in one of our cases was due to this complication. In this instance, incorrect diagnosis and neglect were directly responsible for this complication. Where possible the nidus of infection, the uterus, should be removed, the abdomen drained, sulfadiazine and penicillin given in adequate amounts and the necessary supportive measures carried out. Following any line of treatment, the mortality rate is extremely high.

The maternal mortality varies in the series reported but ranges from 50 per cent to 100 per cent. The fetal mortality is usually quoted higher than that for the mother (90 per cent). In our cases, both mothers died; however, one of the infants lived, though it had been extruded into the abdominal cavity.

SUMMARY

1. Two cases of spontaneous rupture of the uterus are reported, one of which was in a primigravida at approximately 4½ months' gestation, and the other case was at term.
2. Case 1 is unique in medical literature in that sepsis following uterine rupture had resulted in rupture of the anterior abdominal wall and a fetal hand was found protruding from the perforation.
3. Infection as an etiologic agent in rupture of the uterus is thought to be the cause in the primigravida reported.
4. With sudden cessation or great reduction in intensity of labor pains, associated with abdominal tenderness and blood in the urine, one is justified in treating the patient as a case of rupture of the uterus.
5. In Case 2, the delivery of a viable infant was accomplished, though it had been secondary to uterine rupture.
6. Laparotomy is the procedure of choice.

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COCCYGODYNIA

Review of the Literature and Presentation of Cases

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INTRODUCTION

SINCE coccygodynia was first described in 1859 by Simpson, many aspects of this condition relative to etiology and treatment have been presented. Coccygodynia should be of wide interest, not only to the specialist, but also to the general practitioner. Before going further, I think it is wise to get a clear understanding of just what the term means. Coccygodynia, as the name implies, means painful coccyx, but it is a clinical entity that cannot be limited to painful coccyx. In the complete syndrome of symptoms painful coccyx may be just one of the presenting symptoms. This condition may well be called pelvic myoneuralgia.

ANATOMY

It is imperative that the anatomy of the pelvis be known before the relationship of the lesion to the symptoms can be understood.

The muscles involved in this condition are mainly those of the pelvic floor, i.e., piriformis, coccygeus, and levator ani.

The *piriformis*¹ is a flat muscle, pyramidal in shape, arising by three fleshy digitations located between the first, second, third, and fourth anterior sacral foraminae. The muscle leaves the pelvis through the greater sciatic foramen, the upper part of which it fills, and is inserted by a rounded tendon into the upper border of the greater trochanter behind. The sciatic nerve leaves the pelvis through the greater sciatic foramen below the piriformis muscle. Bourgouin² says that the sciatic nerve perforates the belly of the piriformis before passing through the greater sciatic foramen in 10 per cent of cadavers. He quotes Freiburg to the effect that the piriformis is the only muscle that bridges the sacro-iliac joint and that spasm of the muscle may result from sacro-iliac disease or trauma (fig. 2). Beaton and Ansen³ demonstrated 24 variations in the relationship of piriformis muscle to the sciatic nerve in 240 cadavers: 17 of these revealed divisions of the nerve through and below the divided muscle, 5 revealed divisions of the nerve above and below the muscle, and 2 revealed the nerve piercing the muscle (fig. 3).

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The *coccygeus*¹ is a triangular plane of muscular and tendinous fibers arising by its apex from the spine of the ischium and sacro-spinus ligament, and inserted by its base into the margin of the coccyx and into the lowest segment of the sacrum.

It assists the levator ani and piriformis muscles in closing in the back part of the outlet of the pelvis.

The *levator ani*¹ is a broad thin muscle situated on the side of the pelvis. It is attached to the inner surface of the side of the lesser pelvis and unites to form the greater part of the floor of the pelvic cavity. It supports the viscera and surrounds the various structures which pass through it. It arises from the superior ramus of the pubis, from the spine of the ischium, and between these two points from the obturator fascia. It is inserted behind to the last two segments of the side of the coccyx, medially to the muscle of the opposite side and anteriorly it unites with the fellow of the opposite side beneath the prostate gland and joins with the fibers of the sphincter ani externus and transverse perianei at the central tendinous point of the perineum. In the female, the anterior fibers of the levator ani descend upon the side of the vagina (fig. 1).

In Water's⁴ excellent paper on coccygodynia, he states, "The anterior coccygeal surface has attached to it the levator ani and coccygeus muscles and is in close relationship to the posterior rectal wall. Laterally attached is the gluteus maximus and at the tip is the attachment of the anal sphincter. The lower strands of the sacro-sciatic ligaments are attached near the cornua. The nerve supply is rich. On the dorsal surface the posterior divisions of the lower three sacral nerves form loops, and with the coccygeal nerve, supply the skin over the lower end of the coccyx and send filaments to the posterior coccygeal ligaments. The coccygeal plexiform arrangement of nerves, found along either side, is formed mainly from the anterior divisions of the fifth sacral and the coccygeal nerves. Upon the ventral surface of the coccyx the two symmetrical sympathetic trunks unite and terminate in the single median sympathetic ganglion, cocygeum impar. This ganglion connects with the branches of the fifth sacral and coccygeal nerves, thus forming an extensive plexus on the anterior coccygeal surface.

"Filaments from this plexiform arrangement pass to the teno-muscular insertions of the levator ani, coccygeus, gluteus maximus muscles, and the sphincter ani. This plexus also innervates the sacro-coccygeal joint and ligaments."

The superior gluteal nerve leaves the pelvis through the greater sciatic foramen above the piriformis and supplies the gluteus medius

and minimus and ends in the tensor fascia latae. The inferior gluteal nerve leaves the pelvis through the greater sciatic foramen, below the piriformis and supplies the gluteus maximus.



Fig. 1. Sagittal section of the pelvis showing the anatomic relationship of the pelvic floor muscles, i.e., piriformis, coccygeus and levator ani. (Adapted from Spalteholz, Handatlas der Anatomie des Menschen.)

Thiele⁵ points out that cerebrospinal innervation of the anorectum and the genito-urinary organs are supplied by the pudic nerve, derived from the second, third, and fourth sacral nerves. The sympathetic innervation is derived from the pelvic plexuses and their subdivisions. The parasympathetic innervation is derived from the so-called pelvic vagus which has its origin in the first and second sacral segments of the cord, and passes into the pelvis through the second, third, and fourth sacral nerves, supplying the anorectum and all of the genito-urinary system except the ureter.

The innervation of the three above mentioned muscles of the pelvic floor is derived from the sacral nerves (fig. 4).

From the foregoing anatomic descriptions, it can readily be understood that inflammation of any of the pelvic viscera can cause spasm of those muscles, thereby giving rise to the symptoms of cocy-

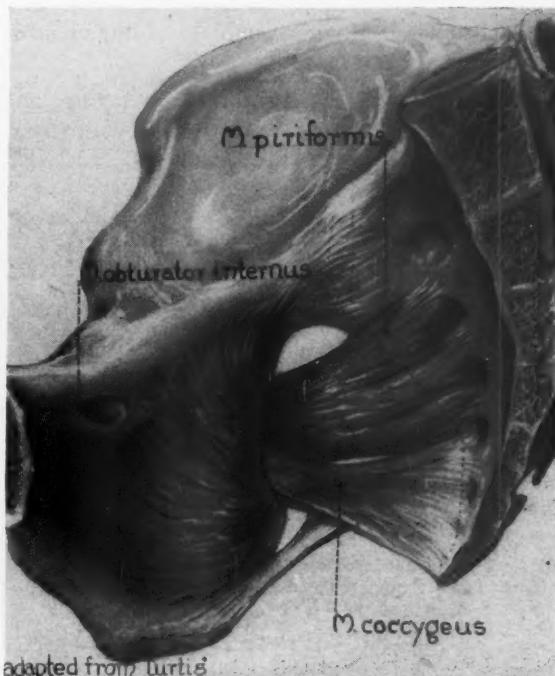


Fig. 2. Illustration demonstrating the upper margin of the piriformis muscle bridging the sacro-iliac joint. (Adapted from Curtis: Textbook of Gynecology, Edition 4, W. B. Saunders Co., Philadelphia, 1943.)

godynia. The importance of this relationship will be considered later.

INCIDENCE

Coccygodynia is much more prevalent in females than in males—20 of the last 23 cases (86.9 per cent) seen at the Laird Memorial Hospital have been females. This compares favorably with Foster's⁶ 100 per cent in 23 cases, Thiele's⁷ 85 per cent in 87 cases, and Duncan's⁸ 97 per cent.

The oldest patient in our series was 64 years of age, the youngest 21, the average being 39.2 years.

SYMPTOMS

May I repeat that coccygodynia is a clinical entity presenting a varied syndrome of symptoms, and results from an imbalance of the pelvic musculature?

Patients with coccygodynia will complain of one or any combination of the following symptoms:

1. *Coccygeal pain*—This is emphasized on sitting, and usually requires pillows or a rubber doughnut. People with this complaint

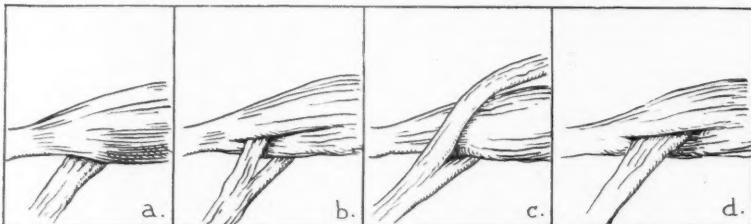


Fig. 3. Abnormalities of the sciatic nerve in relationship to the piriformis muscle:

- a. The normal emergence of the sciatic nerve below the piriformis muscle.
- b. Division of the sciatic nerve through and below the divided muscle.
- c. Division of the nerve above and below the muscle.
- d. The nerve piercing the muscle.

(Adapted from Beaton and Ansen: The Sciatic Nerve and the Piriformis Muscle: Their Inter-relation a Possible Cause of Coccygodynia, *J. Bone & Joint Surg.*, 20:686-688 (July) 1938.)

are unable to take long automobile rides without extreme discomfort. They are more comfortable sitting in an upright position, thereby shifting direct pressure from the coccyx to the ischial tuberosities and gluteal muscles. They often sit on one buttock. Some are more comfortable lying down, others standing. Seventeen of the 23 patients had this complaint.

2. *Rectal pain*—This was the chief complaint in the present series of cases, 21 of the 23 patients being so affected. This pain is usually throbbing in nature and accentuated on defecation. It is often difficult to differentiate between coccygeal pain and rectal pain, in that these patients complain of pain on sitting and cannot actually localize the pain. All but one of our patients had either coccygeal pain or rectal pain, or both.

3. *Supragluteal pain*—with radiation down the thighs.

4. *Lumbar pain*.

5. *Perineal pain*.

6. *Pelvic pain*—many complain of a dull aching or a sensation of fullness inside the pelvis.

All of Thiele's¹ patients had pain in the region of the coccyx, in the supra-gluteal region, or down the back of the thigh. Pain was confined to the coccyx in 30 of his patients.

CLASSIFICATION (as to etiology)

I. Inflammation:

- a. Males:—Urethritis.
 - Seminal vesiculitis.
 - Prostatitis.
 - Cystitis.
 - Anal fissures, hemorrhoids, proctitis, etc.
- b. Females:—Cervicitis.
 - Salpingitis.
 - Cystitis.
 - Vaginitis.
 - Anal fissures, hemorrhoids, proctitis, etc.

II. Trauma:

- Childbirth.
- Fall, kick, or other direct trauma.

III. Psychogenic:

- Hysteria.
- Neurosis.

Inflammation: I believe that inflammation is the chief etiologic factor in coccygodynia. Pelvic imbalance due to inflammation of the pelvic viscera may be explained by reflex spasm of the pelvic floor muscles referable to distant foci or by the close proximity of the affected organs to the pelvic floor muscle or muscles, thereby causing spasm.

Diseases of the anus and rectum will often cause spasm of the levator ani and coccygeus muscles with the resulting symptoms of coccygodynia. The significance of this can be readily realized if we recall, and Bourgouin² reminds us that spasm of the levator ani exerts forward as well as lateral traction on the coccyx. This would cause pelvic imbalance with resulting piriformis spasm. If we remember that the superior gluteal, inferior gluteal, and sciatic nerves leave the pelvis through the greater sciatic foramen in close proximity to the piriformis muscle, we see that sacrosciatic or gluteal pain may result from spasm of this muscle.

Frequently patients with ano-rectal disease will complain of

genito-urinary symptoms and vice versa. Thiele⁵ emphasized this fact in his paper presented before the Southern Medical Association meeting at Cincinnati, in November, 1945. He says: "Vaginismus and consequent dyspareunia may be the chief symptoms of an ano-rectal lesion or the result of ano-rectal surgery. These symptoms are due to spasm of the levator ani as the result of sympathetic and/or cerebrospinal reflexes." He states further: "Pain in the upper rectum, or painful defecation may be the chief complaint in a woman with an abscess in the pouch of Douglas. Pain when sitting, or other of the attendant symptoms of pelvirectal abscess may be the chief complaint of a woman with pelvic inflammatory disease."

Trauma: Trauma is a real, but often overemphasized, etiologic factor in coccygodynia. Key and Conwell⁶ give a rational explanation of pain resulting from trauma. "It is probable that the acute traumatic cases are suffering from contusion of the sacro-coccygeal plexus or sacro-coccygeal sprain, while the chronic cases have a mild arthritis at the sacro-coccygeal joint." Eight, or 35 per cent, of the patients seen at this hospital gave a history of trauma. Of these 8, however, none had any gross abnormality of the coccyx.

This is by no means an unanimous opinion: 87 per cent of Duncan's⁸ patients gave history of trauma. Nixon¹⁰ concludes that injury is the usual cause. Conversely, none of Foster's⁶ 23 patients or of Thiele's⁷ 87 patients gave a history of trauma.

It is not improbable that sacro-iliac disease may cause coccygodynia by causing spasm of the piriformis, which is the only muscle that bridges the sacro-iliac joint (fig. 2). In one case here coccygectomy gave no relief but subsequent sacro-iliac fusion afforded relief of symptoms.

Childbirth undoubtedly is an etiologic factor in coccygodynia, but whether this state is due to later inflammatory complications rather than to immediate trauma to the coccyx, I cannot say. I think it is significant that 17 of the 20 women in this series are multiparous. DeLee and Greenhill¹¹ say that many of the cases of coccygodynia following childbirth are due to dislocations of the coccyx onto the anterior or posterior surface of the sacrum and a pericoccygeal cellulitis. It is their opinion that spontaneous recovery is the usual thing, but it may take many months.

Psychogenic: It is the opinion of many that coccygodynia is a manifestation of hysteria and psychoneurosis. It is more likely that the neurosis is a result of this distressing condition. Duncan⁸ says that painful coccyx is rarely of psychic origin, though neurasthenia

may develop secondary to prolonged and severe pain. We all know, but hate to admit, just how easy it is to label a patient neurotic when we cannot point the accusing finger at the definite etiologic factor.

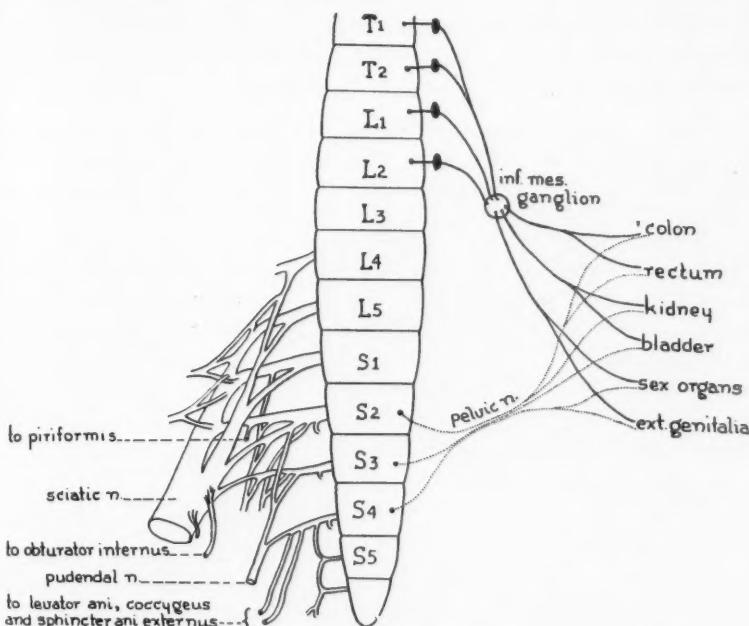


Fig. 4. Highly diagrammatic scheme showing the sacral plexus of nerves on the left and its relationship to the autonomic nerve supply of the pelvic viscera as shown on the right. The broken lines represent the pelvic vagus or parasympathetic innervation to the pelvic viscera. The straight lines represent the sympathetic innervation. From this diagram, it may be seen that the symptoms of coccygodynia may result from inflammation of any of the pelvic viscera by reflex spasm of the pelvic floor muscles.

Although several of this series were at first diagnosed as psycho-neurotic, only one proved to have a psychogenic origin and this was a 46 year old woman with a multiplicity of complaints in whom organic disease was ruled out. Domestic problems were the causative factor in this case.

Babcock¹² says that coccygodynia involves the coccygeal plexus and especially affects neurotic and hysterical women. I am in accord that often the coccygeal plexus is involved, but as stated above, I do not believe that it especially affects neurotic and hysterical women. Duncan⁸ quotes Welcher to the effect that coccygeal

neuralgia or coccygodynia is generally hysterical, but he thinks this is an admission of defeat.

DIAGNOSIS

A careful history is of the utmost importance in attacking the problem of coccygodynia. In any patient complaining of rectal or coccygeal pain or any combination of the previously mentioned symptoms, coccygodynia should be considered.

The most common physical finding is a spasm of one or more of the pelvic floor muscles. The affected muscles have a swollen, beefy feel to the examining finger on rectal examination. There is an enlargement and spasm as compared to the flat, relaxed muscle of the other side. It must be emphasized, however, that this is not necessarily limited to one muscle or the muscles on one side of the pelvis. In Foster's⁶ series, the coccygeus was the muscle most frequently involved. In our cases, the levator ani was the chief offender, but this is of academic interest only, for spasm of any muscle will give symptoms of coccygodynia by the resulting imbalance. If there is severe unilateral spasm, the stool may take on a triangular shape. Laird¹³ first called attention to this condition.

If this disease goes untreated for many years, the affected muscle, due to continued spasm, will become small and feel not unlike bands of banjo strings.

Whether early or late, pressure on the affected muscles will cause exquisite pain and often will duplicate the symptoms of which the patient is complaining.

Once the diagnosis is established, a careful survey of the genitourinary system and rectum should be made and very often an inflammatory lesion of one of the pelvic organs will be found.

X-ray is of no value in diagnosis. Although severe unilateral spasm of the levator ani and coccygeus may pull the coccyx to the affected side, nothing of significance can be demonstrated on x-ray examination that could not otherwise be found on physical examination. Duncan⁷ says that almost any variation of the coccyx, except a fracture or dislocation, that is noted in a patient with a painful coccyx, can be matched in an x-ray of the coccyx of a patient who has never complained of pain in the coccygeal region.

TREATMENT

We believe that the treatment of coccygodynia is entirely non-surgical. There is no indication for excision of the coccyx for coccygodynia per se.

The treatment of coccygodynia is massage. Many of these patients will have gone from doctor to doctor, receiving excision of the coccyx, hemorrhoidectomies, transurethral resections, salpingectomies, etc., in an attempt to get relief from this pain. Many are labeled neurotic and their cases dismissed. It is true that if a patient has an inflammatory lesion, it should be treated in conjunction with massage. If dealing with an acute lesion, it must be arrested prior to massage.



Fig. 5. Modification of Fig. 1 showing that massage of the pelvic muscles must be carried out in the long direction of their fibers. It should be noted that the fibers of the piriformis muscle run obliquely, rather than parallel to, the fibers of the coccygeus and levator ani muscles.

Massage: This is accomplished by inserting the finger into the rectum and massaging the muscle or muscles in the long direction of their fibers (fig. 5). This will cause rather severe pain at first, so gentle massage, followed by increasing pressure as the pain diminishes, is the method of choice. Too active massages at first will cause an increase in the muscle tenderness and will often cause

hemorrhage into the muscles. Three massages per week of about 2 to 3 minutes each seem to give the best results. The number of treatments is dictated by the progress of the patient. The average number in this series of cases was 15. This is more than Foster's⁶ average of 4 such treatments, and Thiele's⁷ average of 11 treatments. Bourgouin² also advocates massage.

Dislocation of the coccyx should be reduced by one finger in the rectum and the thumb outside over the posterior aspect of the coccyx, with care not to injure the rectum, followed by massage.

Sitting Posture: These patients should maintain an erect sitting posture. This throws the weight from the coccygeal region to the ischial tuberosities and gluteal muscles. Some find a measure of relief with a rubber cushion or doughnut. A chair with an erect back and the seat slanted posteriorly affords some relief by shifting the weight to the thighs, tuberosities, and gluteal muscles. Long automobile rides should be discouraged.

Heat: Daily hot Sitz baths give relief to some, but increase the symptoms of others, probably because they attain a semiprone position with most of their weight directly on the coccyx. This should be encouraged if it affords relief and discouraged if not. An electric heating pad or heat lamp applied to the lumbar area is often helpful.

Dureck¹⁴ recommends hot rectal douches at 105° F. for 10 minutes, followed by hot Sitz baths at 110° F. for 30 minutes, and also hot wet blankets around the entire pelvis.

Relief of Constipation: A mild laxative to insure soft stools without diarrhea is advisable. Often mineral oil, ounces one, morning and evening, will suffice. This is important when we consider that many of these patients complain of throbbing rectal pain that is accentuated on defecation.

Coccygodynia with a psychogenic origin may be treated with massage and psychotherapy, but the prognosis should be guarded.

Nixon¹⁰ advises excision of the coccyx.

Hobart¹⁵ advocates manipulation and, if this fails, excision of the coccyx.

Excision of the coccyx has been very unsatisfactory. The last 12 patients having excision of the coccyx at this hospital were sent questionnaires as to the results. Of these, 8 answered, and only one reported relief of symptoms.

The last 11 patients seen at the Laird Memorial Hospital with a diagnosis of coccygodynia were treated by massage. Eight of

these patients, or 73 per cent, were relieved. One of psychogenic etiology showed immediate improvement after massage, but was later seen with the same complaint. The other 2 were advanced cases, having gone to the banjo string stage.

CASE HISTORIES

CASE 1. Mrs. R. B., a 21 year old housewife, was seen in February, 1942, at which time she had an incomplete abortion for which she received a hysterotrachelectasia. She was seen on four other occasions with complaints of low abdominal discomfort, low back pain, sacrococcygeal pain, and pelvic pain. She received excision of the coccyx following a diagnosis of coccygodynia in February, 1944. On Jan. 14, 1946, the patient was readmitted with a history of having had no relief from previous procedures, including excision of the coccyx. At this time she was complaining of low abdominal pain, low back pain, rectal pain, and supragluteal pain. Pelvic examination at this time revealed no abnormalities of the pelvic viscera. Rectal examination revealed spasm of the left piriformis and right levator ani muscles. A diagnosis of coccygodynia was again made and she received daily massages to the affected muscles for 12 days, with complete relief of symptoms.

CASE 2. The latest patient seen at this hospital with diagnosis of coccygodynia was a 29 year old school teacher who had had low back pain and supragluteal pain for the past 2 years. She stated that this pain was not incapacitating, but was making her extremely nervous and irritable, as well as causing constant discomfort. She stated that this discomfort required her to stand most of the time because of pain in the coccyx and low lumbar region that was caused by sitting. A thorough check of the genito-urinary system and rectum revealed no abnormalities except slight erosion of the cervix which was cauterized with silver nitrate. On rectal examination there was spasm of the coccygeus and levator ani muscles on the left and the coccyx appeared to be pulled to the left. After one massage of 2 to 3 minutes, the patient returned stating that the massage had afforded her more comfort than at any time during the past 2 years. At the end of 4 days she received another massage. Her associates in the high school informed me that she is a changed person. She will receive several more massages before discharge.

CASE 3. Mr. J. B. M., age 50, was admitted with a chief complaint of rectal, supragluteal, perineal, and lower abdominal pain of 9 years' duration. He stated that the illness was disabling. The initial symptoms were frequency of urination associated with a urethral discharge. He later developed rectal pain for which he consulted a proctologist. He had injection of internal hemorrhoids without relief. Later he consulted an orthopedist because of supragluteal pain. The prescribed treatment at that time was a hard bed and back brace. The rectal pain and supragluteal pain persisted. The prostate and seminal vesicles were massaged weekly for many months. He later received a transurethral prostatic resection, with relief of urinary symptoms, but there was no improvement of the supragluteal or rectal discomfort. The coccyx was excised, with aggravation of symptoms. When seen at the Laird Memorial Hospital he was complaining of rectal, supragluteal, perineal, and lower abdominal pain. Rectal examination at that time revealed bands of

adhesions of the banjo string type in the levator ani muscle bilaterally. He received massage twice weekly for several months without relief of symptoms. The purpose of presenting this case is to emphasize the importance of early diagnosis, for if this patient had received massage in conjunction with the surgical procedures the symptoms of coccygodynia probably would not have persisted. Once the banjo string stage has been reached, the prognosis is poor.

CONCLUSIONS

1. Coccygodynia is a clinical entity that cannot be limited to painful coccyx. It is a syndrome of symptoms and painful coccyx may be just one of the presenting symptoms.
2. Inflammatory lesions of the genito-urinary system, and rectum are the most frequent etiologic factors.
3. The pain of coccygodynia is due to a spasm of one or more of the pelvic floor muscles, i.e., piriformis, coccygeus, or levator ani. Coccygeal pain, throbbing rectal pain, or both, were complaints in all but one of the cases presented.
4. Massage of the pelvic floor muscles in the long direction of their fibers is the treatment of choice. The foci of infection must be adequately treated and supportive measures carried out in conjunction with massage. There is no indication for excision of the coccyx for coccygodynia per se.

Twenty-three cases of coccygodynia are presented and the literature is reviewed.

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WAR EXPERIENCES IN THE TREATMENT OF SPINAL CORD INJURIES

Perhaps the most complex problem presented to the Medical Corps of the Army and Navy during the recent war, was the management of patients who had received spinal cord injuries. For this purpose the services mustered their full strength, sparing no expense to give these extremely unfortunate individuals every opportunity to make as complete a recovery as was possible and to become adjusted to their necessarily difficult existence.

At the same time it provided one of the greatest examples of group therapy ever witnessed because the successful treatment of this tragic condition required the combined services of experts and specialists from many professional and subprofessional fields. The close teamwork that was developed by the men and women who participated in this program demonstrated conclusively what can be accomplished by cooperative effort in the treatment of a condition that has been considered to be almost hopeless.

It was the Army that had the largest number of these patients to deal with because it was the ground soldier who received the fragmentation or bullet wound. Special centers were therefore set up in several Army general hospitals where all of these patients were sent for treatment, with an average of 75 in each center. This

Read before Symposium on Fractures and Other Trauma, Cleveland Session, Clinical Congress, American College of Surgeons, December 16-20, 1946.

plan of grouping such patients became the first important advance in the treatment of this condition for two reasons:

First and all important was the boost in the morale of the injured soldier when he lived in close association with others whose condition was as bad as his or frequently even worse. Secondly, a large number of trained personnel was required, including professional, semi-professional, and technical workers, plus a tremendous amount of special equipment which was needed in the wards, gymnasium, physical medicine and other hospital departments.

The second advance was more concerned with our ways of thinking in regard to the treatment of paralyzed patients. Before the war it was felt by most of us that an individual who received a serious injury to the spinal cord was doomed to a slow but sure death over an average period of one to two years, caused by ascending infection of the urinary tract. As a result of our war experience we know that this gloomy outlook is not justified by results obtained and that the paraplegic individual can be restored to a reasonably comfortable existence with a much extended expectancy of life. However, to obtain such a result attention should be directed again to the complexity and extensiveness of the treatment program, which taxes the initiative and endurance of the patient to a straining point, and this fact points up our third and last general observation.

The final result is, to a large extent, determined by the patient himself, and, regardless of how much we attempt to do for him, in the final analysis it is his decision that determines how much he will accomplish. It is one thing to talk about becoming ambulatory without the use of one's legs but it is another to develop the huge trunk and arm muscles by hard daily efforts that are required for use as a poor substitute. And since the average school age of our patients was at the eighth grade level, our efforts with a non-compulsory educational and training program went only so far as the ambition of the patient dictated. Parenthetically it might be noted that the reasonably generous pension allotted by the Veterans Administration was enough to stymie much desire by the individual to earn more money through his own efforts.

When one attempts to name the more specific advances made in the treatment of spinal cord injuries, the list becomes long and includes the management of practically every phase of the condition. As stated before, a sizable group of specialists and technicians working as a team were required to carry out such a complete program and each of them has made worthwhile improvements in methods of treatment. We therefore present them chronologically,

beginning with the admission of the soldier patient to a neurosurgical center in a general hospital in this country.

Attention should be called first to the extreme importance of having all details of this program under the single care of one physician. Experience has proven this to be the one and only manner in which all parts of such an extensive regimen can be carried out to the greatest advantage of the patient. So much must be done for these individuals over such a long period of time that the full time of one person was required to see that all details were carried out on a very rigid schedule. The response of the patient to such a plan was pleasant to observe because he soon learned that his doctor was also his friend who saw to it that he received every care and attention that was needed. Such a strong doctor-patient relationship became a tremendous boost to morale and often provided the patient with his first desire to recover and go through with such a major readjustment.

The more important advances in treatment might well be listed under the specialties involved:

A. Urology:

1. Tidal drainage (modified).
2. Early closure of cystostomy.
3. Development of degree of automatic bladder control.
4. Treatment of infection of the urinary tract using chemotherapy and antibiotics (particularly streptomycin).
5. Early detection and removal of calculi, and measures to prevent their formation.
6. Operative procedures to reduce amount of residual urine in bladder (resection of bladder neck).

B. Neurosurgery:

1. Laminectomy if necessary to improve condition by removal of foreign bodies, release of adhesions or other procedures.
2. Medical (curare) and surgical measures (rhizotomy) to relieve troublesome mass reflexes and pain.
3. Experimental operative procedures for stimulation of distal segment of cord and nerves.

C. General and Plastic Surgery:

1. Care and early closure of decubitus ulcers, by direct suture and special grafting methods (pedicle and flap).
2. Early closure of colostomies and care of other associated conditions.

D. Internist and Nutritionist:

1. Prompt correction of secondary anemia, avitaminosis, hypoproteinemia, with restoration of positive nitrogen balance, and correction of A/G ratio.
2. Clinical surveys at regular intervals.

E. Orthopedic Surgery:

1. Application of braces, crutches, walkers and special apparatus for early ambulation.
2. Operative procedures for stabilization of joints and sections of tendons and muscles.
3. Amputation of totally useless limbs was advocated in certain instances but never performed.

F. Physical Medicine:

1. Rigid routine of exercises in bed and gymnasium to develop adequate trunk and shoulder girdle muscles for ambulation.
2. Use of various therapeutic procedures (hydrotherapy, electric stimulation, massage, light radiation, et cetera).
3. Use of special equipment and apparatus to permit ambulation.

G. Education and Training:

1. Regular school and college subjects.
2. Special educational program.
3. Training for occupations, vocations, skills or trades to permit self-support.

H. Psychiatrist or Psychologist and Ministers:

1. Management of individual problems concerned with readjustment and relations with family and society.

CONCLUSIONS

Valuable improvements in the methods of treatment of patients with spinal cord injuries has resulted from our experiences during the recent war. Patients can be relieved of serious infection of the urinary tract, decubitus ulcers can be closed, a proper nutritional status can be obtained and training to make the individual self-supporting can be carried out. All of this was accomplished by close teamwork between groups of specialists and technicians who carried out this program in many Army and Navy hospitals.

DAVID HENRY POER, M.D.

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